# CONVENTION ON NUCLEAR SAFETY

# 8th NATIONAL REPORT

**Prepared by Government of Republic of Armenia for Eight Review Meeting in March/April 2020**

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## Contents


A. Introduction ..... 1
B. Summary ..... 1
1 General Provisions ..... 2
1.1 Existing Nuclear Installations ..... 2
2 Establishing and Maintaining Legislative and Regulatory Framework ..... 3
2.1 Legislative and Regulatory Framework of the Republic of Armenia ..... 4
2.2 National Safety Requirements and Regulations ..... 4
2.3 System of Licensing ..... 7
2.4 System of Regulatory Inspection and Assessment ..... 9
2.5 Enforcement of Applicable Regulations and Terms of Licences ..... 11
3 Regulatory Authority ..... 12
3.1 Establishment of the Regulatory Body ..... 12
3.2 Status of the Regulatory Body ..... 17
4 Responsibility of Licence Holder ..... 17
5 Priority to Safety ..... 18
6 Financial and Human Resources ..... 20
6.1 Financial Resources ..... 20
6.2 Human Resources ..... 20
7 Human Factors ..... 22
8 Quality Assurance ..... 23
9 Assessment and Verification of Safety ..... 25
9.1 Assessment of Safety ..... 25
9.2 Verification of Safety ..... 30
10 Radiation Protection ..... 31
11 Emergency Preparedness ..... 35
11.1 Emergency Plans and Programs ..... 36
11.2 Information of the Public and Neighboring States ..... 41
12 NPP Siting ..... 42
12.1 Evaluation of Site Related Factors ..... 42
12.2 Impact of the Installation on Individuals, Society and Environment ..... 44
12.3 Re-evaluation of Site Related Factors ..... 44
12.4 Consultation with other Contracting Parties Likely to be Affected by the Installation ..... 46
13 Design and Construction ..... 47
13.1 Implementation of Defense in Depth ..... 47
13.2 Incorporation of Proven Technologies ..... 49
13.3 Design for Reliable, Stable and Manageable Operation ..... 50
14 Operation ..... 50
14.1 Initial Authorization ..... 51
14.2 Operational Limits and Conditions ..... 51
14.3 Procedures for Operation, Maintenance, Inspection and Testing ..... 52
14.4 Procedures for Responding to Operational Occurrences and Accidents ..... 53
14.5 Engineering and Technical Support ..... 53
14.6 Reporting of Incidents Significant to Safety ..... 54
14.7 Operational Experience Feedback ..... 55
14.8 Management of Spent Fuel and Radioactive Waste on the Site ..... 58
Annex 1. The International Treaties Ratified by the Republic of Armenia ..... 63
Annex 2. Government Decrees Adopted in Atomic Energy Utilization Field ..... 64
Annex 3. Road map ..... 68
Annex 4. Position of ANRA in the RA Government Structure ..... 69
Annex 5. Organizational Structure of ANRA ..... 70
Annex 6. Radiation Protection ..... 71

Annex 7. Scheme of ANRA Emergency Response and Interaction with External Organizations ..... 75
Annex 8. Armenian NPP Notification Scheme ..... 76
..... 76
Annex 9. Radioactive Waste Management ..... 77
List of Abbreviations ..... 78

## A. INTRODUCTION

The eight National Report of the Republic of Armenia (RA) provides an overview on the implementation of the obligations undertaken by the country under the Convention on Nuclear Safety.

The nuclear program of RA is concentrated on bringing the national legal and regulatory infrastructure on nuclear and radiation safety in line with the IAEA safety standards and the EU directives under the Comprehensive and Enhanced Partnership Agreement signed between RA and EU in November 2017, continuous safety improvement of the Armenian Nuclear Power Plant (hereinafter referred to as Armenian NPP) and development of efforts to ensure the country's energy security and independence.

The national report has been prepared in accordance with the Guidelines regarding the National Reports under the Convention on Nuclear Safety and addresses the principles of the Vienna Declaration on Nuclear Safety.

## B. SUMMARY

The RA ratified the Convention on Nuclear Safety on 24 September 1997.

This report addresses changes in the national legislation, describes practices, challenges and issues related to the nuclear safety, the licensing system, as well as demonstrates the efforts put to improve the nuclear safety by enhancing the national arrangements and developing the international cooperation to meet the obligations under the Convention on Nuclear Safety.

The RA operates one nuclear power plant – Armenian NPP Unit № 2. The Armenian NPP Unit № 2 is operated in accordance with the license issued by the Armenian Nuclear Regulatory Authority (ANRA) on 1 April 2011. Armenian NPP provides in average 45% of the electricity consumed in the country and is a very important component of the national economy that ensures the energy security of the country. The safety upgrades as specified in the List of the Armenian NPP Safety Upgrades are continuously implemented to improve the safety level of the Armenian NPP.

The "Law on Construction of New NPP Unit(s) in the Republic of Armenia" was adopted on 27 October 2009. The "Armenia Development Strategy for 2014-2025" adopted under the RA Government Decree №442-N on March 27, 2014 outlines the energy development plan up to 2025, including approximate dates for installing new capacities. The document outlines the Government's intention to construct nuclear power plant unit(s) aimed to strengthen the country's energy independence and energy security.

However, the RA Government decided to initiate the construction of new nuclear power unit(s), at the same time it undertakes necessary actions on the design lifetime extension of the Armenian NPP Unit № 2. In this regard, on April 19, 2012 the RA Government adopted a decree № 461-N on design lifetime extension of the Armenian NPP Unit №2. Based on the aforementioned decree on August 23, 2012 another decree № 1085-N was adopted on approval of the requirements to the design lifetime extension for the Armenian NPP Unit №2 operation. Based on the latter the licensing plan of the Armenian NPP design lifetime extension has been established. The LTE measures are in process of implementation at Armenian NPP Unit №2 with the expert support from the IAEA, RF, EC and other partners.

The measures undertaken by the RA to implement the obligations undertaken under the Convention on Nuclear Safety take into account the relevant principles of the Vienna Declaration on Nuclear Safety, i.e. regular and systematic safety assessments are performed and the safety improvements are implemented at Armenian NPP in accordance with the approved programs and schedules; the national requirements and regulations are developed and updated in accordance with the IAEA safety standards and good international practices. The mentioned information is addressed in the relevant chapters of this national report, in particular in the chapters 1,9,12,13,14 respectively.

**International peer review missions hosted by the Republic of Armenia in the reporting period**

**Integrated Nuclear Security Support Plan Review Mission**

The IAEA INSSP Review Mission for Armenia was completed from 6-9 November 2017. The objective of the INSSP Review Mission was to review and update Armenia's INSSP in order to identify achievements, update completed activities and to identify and prioritize needs for further implementation of nuclear security activities in Armenia. The new INSSP and the INSSP Implementation Plan for Armenia covering 2018-2020 were developed as a result of the INSSP Review Mission.

**Pre-SALTO (Safety Aspects of Long Term Operation) peer review mission**

The IAEA Pre-SALTO mission was completed at the Armenian NPP Unit №2 from 28 November to 7 December 2016. The pre-SALTO mission reviewed the status of the completed, in-progress and planned activities at the NPP for it safe long-term operation (LTO). The team found that the NPP approach and preparatory work for safe LTO generally follows international practices, however not all activities are in line with the intent of the IAEA Safety Standards. The team identified some fundamental areas for further improvement.

**SALTO Peer Review Mission**

The IAEA SALTO mission was completed at the Armenian NPP Unit №2 from 27 November to 6 December 2018. The SALTO mission focused on the status of activities related to the NPP LTO. The team reviewed the completed, in-progress and planned activities related to LTO, including Ageing Management of the Systems, Structures and Components important to safety and revalidation of Time-Limited Ageing Analyses. Through the review of information obtained from available documents, programmes, presentations and discussions with counterparts and other members of the NPP staff, the IAEA team identified areas for improvement.

**IRRS (Integrated Regulatory Review Service) follow-up Mission**

The IRRS follow-up mission was completed from 10 to 17 June 2019. The objective of the mission was to review the implementation of recommendations and suggestions made during the initial IRRS mission in 2015. The team found that since 2015, Armenia has taken key steps for radioactive waste by adopting a strategy for spent fuel and radioactive waste management, and by intensifying inspections related to emergency preparedness and response. Armenia is still addressing some other recommendations and suggestions from the 2015 mission, in part because the country is undertaking a comprehensive legislative review process.

The Republic of Armenia plans to host the EU Stress-test Peer-Review Follow-up Mission in November 2019.

# 1 GENERAL PROVISIONS

## 1.1 EXISTING NUCLEAR INSTALLATIONS

### *Article 6. Existing Nuclear Installations*

***Each contracting party shall take appropriate steps to ensure that the safety of nuclear installations at the time the Convention enters into force for that contracting party is reviewed as soon as possible. When necessary in respect to the Convention, the contracting party shall ensure that all reasonably practicable improvements are urgently made to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be outlined to shut down the nuclear installation as soon as practically possible. The timing of the shutdown may take into account the general situation in energy production and potential alternatives, as well as the social, environmental and economic consequences.***

There is only one nuclear installation in the RA covered under the Convention on Nuclear Safety - Armenian NPP. The construction of the Armenian NPP was started in 1969. The Armenian NPP design is based on the first generation of V-230 reactor and takes into account the seismic specifics of the plant site. Armenian NPP consists of two WWER-440 type units, designated as version V-270. The Unit № 1 was commissioned in December 1976, and the Unit №2 - in January 1980. The installed capacity of each unit is 407,5 MW, and the design lifetime is 30 years. The Armenian NPP was shutdown shortly after the Spitak earthquake on December 7, 1988, with its epicenter located 80 km north of the NPP site. Though the NPP did not suffer any damage, and both units remained in operation, the USSR Board of Ministers adopted decree to shutdown the Armenian NPP. Thus, the Unit №1 was shutdown on February 25,1989 and the Unit №2 - on March 18, 1989. Both units were in long-term shutdown condition, but not decommissioned. To overcome the energy crisis on April 07, 1993 the RA Government adopted a decree to restart the Armenian NPP Unit №2. Before and after the Armenian NPP Unit №2 restart, several hundred safety upgrades were developed and implemented and are continuously implemented in accordance with the RA Government Decree № 474 as of October 05, 1994 on approval of the Concept for the Armenian NPP Restart and the List of the Armenian NPP Unit №2 safety improvement measures, which is periodically revised and updated taking into account the operation experience of Armenian NPP and of other countries operating similar NPPs, new IAEA safety standards, recommendations and suggestions made by the expert and peer review missions organized in frame of the international and technical cooperation projects with the IAEA, EC and other countries and international organizations.

The following safety related measures have been implemented in the reporting period covering 2016-2019:

- Implementation of new antiseismic protection systems of Armenian NPP Unit №2 reactor (SIAZ-3);
- Modification of the reactor control and protection system of Armenian NPP Unit №2;
- Modernization of spray system.

The following safety related measures are in the process of implementation:

- Modification of in-vessel control system of Armenian NPP Unit №2;
- Modernization of the emergency core cooling system;
- Modernization of the reliable power supply system of Armenian NPP Unit №2;
- Modification of DEF-200.

The licensing plan of the Armenian NPP design lifetime extension has been established following the Government Decree № 1085-N as of August 23, 2012 on approval of the requirements to design lifetime extension for the Armenian NPP Unit №2 operation. The licensing plan of the Armenian NPP design lifetime extension has been approved by ANRA on July 14, 2015.

The following the safety related measures covered in the licensing plan are in process of implementation:

- Modification of the Emergency Core Cooling System;
- Modification of the Sprinkler System;
- Measures aimed to establish LOCA-200 as design basis accident.

# 2 ESTABLISHING AND MAINTAINING LEGISLATIVE AND REGULATORY FRAMEWORK

### *Article 7. Legislative and Regulatory Framework*

1. ***Each contracting party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.***
2. ***The legislative and regulatory framework shall provide for:***

   ***(i) the establishment of applicable national safety requirements and regulations;***

   ***(ii) a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;***

   ***(iii) a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;***

   ***(iv) the enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation.***

## 2.1 LEGISLATIVE AND REGULATORY FRAMEWORK OF THE REPUBLIC OF ARMENIA

A constitutional referendum was held in Armenia on December 6, 2015. Its amendments to the constitution put the country on a course from having a semi-presidential system to being a parliamentary government.

The RA signed the Comprehensive and Enhanced Partnership Agreement (CEPA) in November 2017. The roadmap has been developed to harmonize the national legislation with the EU directives. ANRA has undertaken responsibility to bring the legal regulatory infrastructure for nuclear safety in conformity with 5 EU directives (Annex 3).

The Constitution of the RA has the highest legal force and its provisions are directly applied.

Laws that should comply with the constitutional laws and laws and belong to the first level of legislative framework on the nuclear safety regulation.

Decrees of the RA Government and the RA Prime Minister belong to the second level of the legislative framework.

Regulations approved by the ANRA Chairman, registered by the Ministry of Justice of the RA and named "subordinate acts" belong to the third level of the legislative framework.

Guides, methodologies, industrial standards and so on belong to the forth level of the legislative framework.

The intentional treaties of the RA are integral part of the legislative framework and also belong to the first level. If the international treaties ratified by the National Assembly of the RA stipulate provisions other than the ones stipulated in the laws, the provisions of the ratified international treaties are applied. The list of international treaties ratified by the RA is provided in Annex 1.

## 2.2 NATIONAL SAFETY REQUIREMENTS AND REGULATIONS

The following laws directly pertain to the nuclear safety and belong to the first level of the legislative framework:

- The Code of the RA on Administrative Offenses, as amended in 1996. The amendments empower the ANRA to impose sanctions (warnings and fines) to offender of the legislation in the field of atomic energy utilization;
- The Law of the RA on Environmental Impact Expertise as of 20.11.1995;
- The Law of the RA on Population Protection in Emergencies (№ N-265 as of 09.12.1998) that establishes organization of population protection in emergency situations, rights and

responsibilities of the state and local authorities, entities, officials and citizens involved in the national emergency response system;

- The Law of the RA on organization and conduct of inspections (№ HO-172 as of 17.05.2000) that settles relations concerned with organization and conduct of inspections and examinations of practices of entities as well as of individual entrepreneurs;
- On May 30, 2001 (with further amendments as of 16 March 2004) the National Assembly (Parliament) of the Republic of Armenia adopted the Law on Licensing that establishes types of practices subject to licensing in the atomic energy utilization field and settles relations related to licensing;
- On March 1, 1999 the National Assembly (Parliament) of the Republic of Armenia adopted the Law on Safe Utilization of Atomic Energy for Peaceful Purposes, which is the basic legal document for settling relations in the field of the atomic energy utilization and is called to ensure fulfillment of obligations of the RA under the international treaties in the field of atomic energy utilization;
- On April 18, 2003 the National Assembly (Parliament) of the Republic of Armenia adopted the Criminal Code of the RA that specifies the types of crimes and liabilities in the field of atomic energy utilization.

Decrees of the RA Government and the Prime Minister belonging to the second level of the legislative framework settle down specific relations.

The complete list of the legal acts (laws, legal acts, subordinate acts) enforced in the RA is provided in Annex 2.

Legal acts, that are approved by ANRA and registered by the Ministry of Justice of the RA (and that are binding), are adopted in accordance with the legal acts having higher legal force. These legal acts belong to the third level of the legislative framework, are named subordinate acts and settle down specific issues.

The relations concerned with development, agreement and approval of legal acts are settled down in the Law of the RA on Normative Legal Acts. Thus, in accordance with the procedure established, a draft legal act developed by ANRA prior to submission to the RA Government for adoption (in case of laws - for approval) should be submitted to the concerned authorities (ministries, state authorities under the RA Government) for consent and posed on ANRA web site.

In accordance with the Law of the RA on Normative Legal Acts the following documents should be submitted in support to a draft legal act:

- Justification for adoption of legal act;
- Drafts legal acts concerned with adoption of legal act or a note on absence a need to adopt them;
- A note on changes in the state budget concerned with adoption of legal act.

The ministries and state authorities make their comments and proposals to submitted draft legal acts. Based on these comments and proposals ANRA makes corrections and adjustments to draft legal act, as necessary, and submits it to the RA Government. If the concerned ministries and state authorities make comments and proposals, ANRA submits a note with justification of accepted comments and proposals as well as justification on the reasons for non-acceptance of proposals or comments made.

The same procedure is applied also to the process of amendment or supplement of the adopted legal acts.

## The legal acts were adopted in the reporting period

### Decrees of RA Government/Prime Minister

- RA Government Decree №978-N as of September 22, 2016 on amendments and supplements to the RA Government Decree № 1263 as of December 24, 2001 on approval of the special rules

on transport of nuclear and radioactive materials. The decree clarifies the requirements to safe transportation of nuclear and radioactive materials to reduce the risk of exposure to the environment, personnel and population during transportation of nuclear and radioactive materials;

- RA Government Decree № 1234-N as of December 01, 2016 on amendments and supplements to the RA Government Decree № 1489-N as of August 18, 2006 on approval of radiation safety rules and RA Government Decree № 631-N as of June 04, 2009 on approval of the procedure on radioactive waste management. The decree establishes new requirements and approaches to radiation safety and radioactive waste management in compliance with the new IAEA safety standards;
- RA Government Decree № 1329-N as of October 19, 2017 on amendments and supplements to the RA Government Government Decree № 553-N as of May 03, 2007 on approval of procedure on detection and isolation of radioactive materials. The decree clarified the relations related to detection and isolation of radioactive materials in the Republic of Armenia, as well as the legal relations related to import of radioactive or radioactive materials and items detected on the border and having no licence (permission);
- RA Government Protocol Decision № 52 as of October 14, 2017 on approval of the methodology on assessment of radiation consequences of emergency situations in nuclear installations. The decree approves the methodology for evaluating radiological consequences of accidents occred at nuclear installations, which will allow to establish precisely the emergency planning and response measures to ensure that the personnel, population and environment are protected against possible harmful impacts of ionizing radiation;
- RA Government Decree № 1424 as of November 09, 2017 on amendments and supplements to the RA Government Decree № 631-N as of June 04, 2009 on approval of the procedure on radioactive waste management. The decree settles down the relations on radioactive waste characterization and associated processing, conditioning, storage and disposal and establishes the requirements in compliance with the latest internationally recognized approaches on the safe management of radioactive waste;
- RA Government Decree № 475-N as of May 11, 2017 on amendments to the Government decree № 1231-N as of September 11, 2003 on approval of the concept of physical protection and security of Armenian NPP and nuclear materials and rules on physical protection of nuclear installations and nuclear materials. The new revision deals with the physical protection of nuclear materials and nuclear installations in accordance with the international obligations of the Republic of Armenia, in particular the amendment to the Convention on the Physical Protection of Nuclear Materials and in accordance with the new IAEA safety standards. The decree stipulates new concepts, new requirements for design threats, requirements for information protection, classification of nuclear materials, requirements for physical protection zones and a number of other issues. Then, under the Prime Minister's Decree № 695-A as of June 06, 2017, an interdepartmental commission has been established, which has developed the design based threat of nuclear materials and nuclear installations;
- RA Government Decree № 751-N as of June 06, 2018 on amendments to the RA Government Decree № 2013-N as of November 21, 2002 on approval of the requirements to form and contents of the Safety Analysis Report of the Armenian NPP Unit №2. The decree establishes new, strict requirements for the NPP site characteristics and their analysis, analysis of safety and safety systems and elements, format and content of information submitted in relation to safety analysis and operating experience. The adoption of the decree allows Armenian NPP operational safety assessment to be implemented in line with modern requirements, taking into consideration the best international practice in the field and lessons learned from the Fukushima accident and the results of Armenian NPP Unit №2 operation lifetime extension;
- RA Government Decree № 61-N as of January 31, 2019 on amendments to the RA Government Decree № 1791-N as of February 09, 2005 on approval of the licensing procedure and licence

form for transport of radioactive materials and radiation generators. The decree establishes the provisions on physical protection of radioactive materials, radioactive materials, and emergency response to ensure that a licensee is able to provide physical protection and possible emergency response functions when transporting radioactive materials;

- Draft decree of the RA Government on supplements to the RA Government Decree № 400-N as of March 24, 2005 on approval of the licensing procedure and licence form for operation of nuclear installations was developed and submitted to the concerned ministries for review and to the RA Government to approval;
- Draft decree of the RA Government on supplements to the RA Government Decree № 1085-N as of August 23, 2012 on approval of the requirements to design lifetime extension for Armenian NPP Unit №2 operation was developed and submitted to the concerned ministries for review and to the RA Government to approval.

**Orders of Regulatory Authority**

- ANRA order №125-A as of May 16, 2017 on approval of the requirements for Aging Management System of the NPP safety important systems;
- ANRA order №126-A as of May 16, 2017 on approval of the equipment qualification requirements;
- ANRA order №127-A as of May 16, 2017 on approval of the Requirements for Maintenance Effectiveness monitoring;
- ANRA order №323-L as of December 28, 2018 on approval of the procedure for authorization of implementation of safety important measures during NPP operation.

The complete list of subordinate acts is provided in Annex 2 of the national report.

## 2.3 SYSTEM OF LICENSING

The licensing related relations are settled down under the Law of the RA on Licensing, the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes and the relevant licensing procedures approved by the RA Government.

The following practices in atomic energy utilization field are subject to licensing:

- Site selection, design, construction, operation, and decommissioning of nuclear installations;
- Use, transport and storage of nuclear materials;
- Physical protection of nuclear installations and nuclear materials;
- Expertise of designs and other documents of nuclear installations;
- Physical persons implementing practices and holding positions important to safety in atomic energy field and other.

For instance, the RA Government Decree № 400-N as of 24.03.2005 on approval of the licensing procedure for operation of nuclear installations specifies the requirements to licensing operation of nuclear installations, the list of application supporting documents, the requirements mandatory for obtaining a license, the provisions related to review of application and its supporting documents, rejection of license application and other issues.

In accordance with the established procedure ANRA reviews application for obtaining licence for construction, operation and decommissioning of nuclear installations within 30 days after receiving all documents stipulated in the law, and grants or rejects licence within 180 days after all documents are submitted. The Law of the RA on Licensing specifies also provisions for extension of licence validity period.

Thus, ANRA establishes a licensing commission to make conclusions on granting, termination or revocation of license; the statute of the licensing commission is approved by ANRA. The licensing commission organizes sessions to review licence applications. Applicant is duly notified about review not later that in 7 days in advance with indication of venue (address) where review takes place, date and time. Non-participation of applicant in review is not the basis for non-review or rejection of licence application if other date for review is requested by applicant. This request of applicant can be met if he cannot participate in review by reasoned justifications and if postponement of review will not result in violation of terms specified in the legislation. Applicant has the right to involve specialist, expert, auditor, lawyer or interpreter in review. Applicant or his counselors have right to make speeches, answer questions posed by the commission members, request arbitration. Reviews are conducted with open doors. Reviews involving state, official and banking confidential information are conducted with the closed doors. At applicant's request, reviews can be conducted with the closed doors if commercial confidential information will be discussed during review. Journalists, specialists, officials and other persons can be involved in reviews made with the closed doors. The closed-door review process can be audio and video recorded.

Provisions related to the public involvement and awareness of nuclear installation construction are specified in the Law of the RA on Environmental Impact Expertise (Articles 4,5), the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes (Article 10) and the Law of the RA on Construction of New NPP Unit (s) (Article 4). According to the latter, in the process of new NPP unit(s) construction the RA Government in the established order shall, regularly but not later than once in a half a year, inform public and environmental organizations about the progress with implementation of the program on construction of new NPP unit(s).

In accordance with the Law of the RA on Construction of New NPP Unit(s), the RA Government under its Decree № 604-N as of 20 May 2010 on provision of information on implementation of the program on construction of new NPP unit(s) to public and environmental organizations, has established that with the purpose to provide information on implementation the program on construction of new NPP unit(s) the Ministry of Energy (at present Ministry of Territorial Administration and Infrastructure) shall cooperate with environmental organizations, as well as mass media in compliance with the Law of the RA on Freedom of Information.

The Ministry of Energy (at present the Ministry of Territorial Administration and Infrastructure) makes public the information on progress of new NPP unit(s) construction through mass media sources, internet, and other means specified in the RA legislation:

- Not later than once in each six months, through press reports or press releases informs public and environmental organizations about the progress with implementation of new NPP unit(s) construction program;
- As necessary, organizes press conferences as well as meetings of journalists and representatives of environmental organizations with persons involved in new NPP unit(s) construction program;
- In two days before a press conference makes relevant announcements to mass media and environmental organizations that are accredited in advance to participate in the press conference. Announcement about press conference should be posted on the web site of the ministry. The announcement can be disseminated also via newspapers and e-mailed to mass media and environmental organizations;
- As necessary, requests the persons responsible for new NPP unit(s) construction process to prepare publications and expert analysis related to the program;
- During presentations organized on different stages of new NPP(s) construction program, as necessary, organizes visit of journalists and environmental organizations to the new NPP unit site and provides also with press releases and transportation.

In accordance with the Code of the RA on Administrative Offences a legal entity has no right to implement practices subject to licensing without licence, otherwise administrative or criminal liabilities shall be applied. In accordance with the Article 169 of the Code of the RA on Administrative

Offences, the implementation of a practice without licence is subject to a fine at the rates specified in the legislation. The Article 188 of the Criminal Code of the RA stipulates the provisions related to implementation of activities without special permit (licence), causing losses to public or commercial organizations and other as well as enforcement actions to be imposed for each offence.

The right of ANRA to impose enforcement actions is established in the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes, the Law of the RA on Licensing and the Code of the RA on Administrative Offences.

## 2.4 SYSTEM OF REGULATORY INSPECTION AND ASSESSMENT

The inspection is one of the major functions of ANRA to satisfy itself that Armenian NPP fulfills the terms and conditions set out in the authorizations and the regulatory requirements. ANRA's inspections are organized and conducted in accordance with the Law on Safe Utilization of Atomic Energy for Peaceful Purposes, ANRA Statute and the Instruction on organization and conduct of inspections at the NPP.

The inspections are performed in accordance with the schedule approved in frame of ANRA's annual plan on preliminarily determined topics. It is based on the 3-years baseline periodic inspection program developed by ANRA.

ANRA performs the following inspections at Armenian NPP in accordance with its periodic inspection plan:

- Compliance with the requirements of safety rules and regulations in the nuclear energy field;
- Compliance with the license terms and conditions;
- Implementation of QA programs;
- Implementation of ANRA's requirements;
- Organizational structure of NPP;
- Implementation of NPP safety upgrades, modifications of systems and elements important to NPP safety;
- Implementation of periodical examinations of systems and elements important to NPP safety;
- Ageing management system of elements and systems important to NPP safety;
- Technical examination/surveillance;
- Organization of maintenance and repair of elements and systems important to NPP safety;
- Personnel training system;
- Technical and operational documentation system;
- Compliance with the requirements of the technological specifications and instructions on NPP operation;
- Radiation safety and environmental control;
- NPP emergency preparedness;
- Radioactive waste management;
- Fresh and spent nuclear fuel management;
- Nuclear materials accounting system;
- Civil structures;
- Physical protection system;

- Organization of housekeeping;
- System on investigation of NPP event causes;
- Fire protection system.

The design lifetime extension measures of the Armenian NPP are also included in ANRA's inspection plan.

In accordance with the chapter 2 point 7 of the Procedure on conduct of inspections, ANRA undertakes planned and reactive inspections at the Armenian NPP that in its turn can be announced and unannounced.

Planned inspections are performed in accordance with ANRA's work plan. Reactive inspections are performed in connection with accidents and events at the NPP or in accordance with decision of ANRA management.

In case of announced inspections the operating organization is notified by ANRA not later than in 10 days before inspection. Unannounced inspections are performed without advance notification of the operating organization.

The regulatory inspectors use the following methods of inspections:

- Monitoring and direct observation;
- Discussions and interviews with personnel;
- Review and verification of instructions, procedures, records and other documents on ensuring and justification of safety.
- The inspection team collects the following information prior to an inspection:
- Safety norms and rules related to the inspected area;
- Documents related to the organizational structure of the operating organization, quality assurance program for practices implemented by the NPP and related to the inspected area and relevant operational procedures and programmes;
- Terms and conditions of licenses/permits issued by ANRA to the operating organization;
- Information from annual reports and/or safety submittals;
- Information on enforcement actions imposed by ANRA earlier and information on their implementation, and also reporting documents developed based on results of earlier performed inspections;
- Other available information related to the inspection.

Deficiencies detected during inspections are recorded and discussed at the final meeting with the management and responsible staff of the NPP.

In accordance with the chapter 5 of the Procedure on conduct of inspection, results are documented in act (report) if no non-compliance has been detected or act-enforcement if non-compliances have been detected with indication of necessary corrective measures and deadlines. The following information is indicated in the act-enforcement:

- Fact of non-compliance with safety requirement;
- Points of articles with indication of legal acts, norms and rules in atomic energy utilization field non-complied with;
- Requirements to eliminate deficiency detected;
- Deadline for elimination of deficiency.

Act and act-enforcement are signed by the leader of inspection team, all members of the inspection team and transmitted for signature to the NPP Director General.

The resident inspector conducts routine inspections. When detecting non-compliances with the NPP safety requirements the resident inspector issues enforcement to the NPP Director General and informs ANRA about it.

ANRA controls over fulfillment of its act-enforcements and enforcements through:

- Receiving and review of information on fulfillment of requirements of act-enforcements and enforcements and control over timeliness of its submission;
- Verification of fulfillment of act-enforcements and enforcements.

ANRA performs accounting and control over implementation of the enforcement actions applied.

The "Inspection" process of ANRA QMS has been supplemented with a new paragraph describing a mechanism for using feedback from inspections as input for improving the effectiveness of the regulatory processes.

## 2.5 ENFORCEMENT OF APPLICABLE REGULATIONS AND TERMS OF LICENCES

The right of ANRA to impose enforcement actions is established in the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes, the Law of the RA on Licensing and the Code of the RA on Administrative Offences.

The Articles 36 and 37 of the Law of the RA on Licensing specify the cases for suspension and termination when the ANRA has right to suspend and terminate licence.

The Code of the RA on Administrative Offences (Articles 97-97[6]) specifies the types of administrative offences in the atomic energy utilization field and the types of enforcement actions (fines) applied by the ANRA.

The process of application of enforcement actions starts with drawing up a protocol on administrative offence. The protocol should indicate date and venue, name and surname of person drawing up the protocol, information about person committed an offence, time and venue where the offence was committed, subject-matter of offence, the normative document which establishes liability for the present offence, explanatory note of the offender, other information related to the case. The protocol is signed by the person drawn up the protocol and by the person committed the offence (offender). If the offender refuses to sign the protocol, the indication on that should be appropriately made. The offender has right to give explanations and comments to the protocol content which are to be attached to the protocol, as well as to express in writing reasons of his refusal to sign the protocol. While drawing a protocol the offender is notified of his rights and responsibilities and this is relevantly indicated in the protocol. The protocol is the basis for investigation of a case with offence. Authority (official) investigating the case when detecting causes and conditions resulting in administrative offence, makes relevant proposals on undertaking measures intended to eliminate those causes and conditions.

Having investigated the case on administrative offences the official makes one of the following decisions:

- Impose administrative penalty;
- Withdraw the case.

Decision on administrative offence is mandatory for implementation by state and public authorities, entities, officials and citizens. Decision on the case on administrative offence can be appealed in court by person to whom it was applied as well as by aggrieved party.

In the reporting period 25 administrative offences (fines) were applied to the Armenian NPP management.

Thus, the RA has established and maintains the legislative and regulatory framework for nuclear installations safety that includes:

- Establishment of relevant national requirements and regulations on safety;
- System for licensing of nuclear installations and prohibiting to operate nuclear installations without licence;
- System of regulatory inspections and assessment to confirm the compliance with the requirements specified in the regulations and licence terms;
- Enforcement of requirements specified in the applied regulations and licence terms, including suspension, modification and termination of licence.

# 3 REGULATORY AUTHORITY

***Article 8. Regulatory Body***

1. ***Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfill its assigned responsibilities.***
2. ***Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilization of nuclear energy.***

## 3.1 ESTABLISHMENT OF THE REGULATORY BODY

ANRA was established under the RA Government Decree № 573 as of 16 November 1993 as a state authority under the RA Government empowered to regulate the nuclear and radiation safety in the atomic energy utilization field. In the period 2002-2008 ANRA functioned within the Ministry for Nature Protection of the RA in the status of the inspectorate; in May 2008 under the Ordinance issued by the RA President the inspectorate was reorganized into the State Committee under the Government of the RA on Nuclear Safety Regulation (it was decided to retain the acronym "ANRA"). The statute and the organizational chart of ANRA were approved under the RA Government Decree № 866 as of June 17, 2008. A constitutional referendum was held in Armenia on December 6, 2015. Its amendments to the constitution put the country on a course from having a semi-presidential system to being a parliamentary republic. After the new elections in December 2018, the decision was made to reduce the number of ministries. On May 8, 2019, the RA Law on Amendments and Supplements to the RA Law on "The Structure and Functioning of the Government" (LO-31-N) was adopted, with 12 ministries included in the structure of the government instead of the former 17.

The status of ANRA within the government structure has not been changed and it remains reporting to the government and the prime minister and its statute was approved on July 11, 2018 under the Prime Minister Decree №747-L. The change in RA government structure did not affect ANRA's implementation of its statutory and regulatory functions. ANRA's position within the RA Government Structure is provided in Annex 4.

ANRA is an authority subordinated to the RA Government, implementing the state regulation of nuclear and radiation safety in the atomic energy use. ANRA Chairman is appointed and dismissed by the RA Prime Minister. ANRA Chairman reports to the RA Government and RA Prime Minister. ANRA does not report to any other authority or ministry. ANRA is independent from the agencies responsible for promotion of nuclear energy, has its independent budget (is directly financed from the state budget); ANRA's jurisdictions are established in the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes (Articles 17, $17^1$) and its Statute.

In accordance with the above mentioned legal acts ANRA's jurisdictions are:

a. Development and submission of drafts of normative legal acts related to the atomic energy utilization field to the RA Prime Minister;

b. Licensing of practices and physical persons implementing practices and holding positions important in terms of safety in the atomic energy utilization field;

c. Suspension or termination of license in accordance with the requirements of the international treaties and the RA legislation;

d. Safety assessment, organization and conduct of expertise of practices, installations and equipment in the atomic energy utilization field;

e. Organization and conduct of researches in the atomic energy utilization field for safety improvement purposes;

f. Assessment of investigation of nuclear and radiological incidents that occurred during operation of nuclear installations made by the operating organization and, if necessary, conducts additional investigation and develops a database of violations;

g. Control over compliance with requirements of RA laws related to the atomic energy utilization field as well as terms and conditions of issued licenses by legal entities and physical persons, verification of quality assurance programs of contractors providing services and performing activities important in terms of safety for licensees;

h. In accordance with the RA legislation, imposing administrative offences to licensees breaching the RA laws related to the atomic energy utilization field, safety norms and rules, requirements of sanctions imposed, and in the order established in the law, transmission of the materials related to breach to the law enforcement authorities;

i. Imposing sanctions to licensees binding for implementation when non-compliance with requirements specified in the RA legislation related to the atomic energy utilization field and with terms and conditions of issued licenses is detected and issuing order for termination of activities being implemented in case of threat to the human health and the environment. The right to stop immediately Armenian NPP operation rests with the Chairman, his relevant deputy and the site inspector,

j. Once a year submitting a report to the RA Government on nuclear and radiation safety at the nuclear installations important to safety,

k. Providing information to state and local authorities, entities and mass media on nuclear and radiation safety, as appropriate,

l. Receiving information from the state authorities and entities for the safety assessment;

m. Control on preparedness of licensees to possible emergency situation;

n. In case of emergencies, assessment of situation and on the basis of prognosis on its possible changes submission of proposals on implementation of necessary protective actions to the state authority of the RA empowered with the responsibility for emergency situation related issues;

o. Organization and coordination of the implementation of the Treaty on the Non-Proliferation of Nuclear Weapons and other obligations of the Republic of Armenia;

p. Control over the safeguards implementation in connection the Non-Proliferation of Nuclear Weapons;

q. State registration and maintaining state register of nuclear materials, ionizing radiation sources and radioactive waste;

r. Jointly with the authority empowered with responsibilities for foreign affairs within its jurisdictions control over fulfillment of commitments undertaken under the international treaties of the RA in the atomic energy utilization field;

s. Coordinating the national and regional programs of the RA within the framework of technical cooperation of the International Atomic Energy Agency;

t. Making early international notification on an emergency, in accordance with to the provisions of the Convention on Early Notification in case emergencies at the atomic energy utilization installation or in activities implementing there;

u. Cooperating with international organizations and regulatory authorities of other countries on safety and information exchange, concludes international agreements;

v. Environmental radiation monitoring and control;

w. State regulation (within its jurisdictions) of physical protection of nuclear and radioactive materials and nuclear installations jointly with the RA Police and the National Security Service;

x. ANRA state inspectors perform inspections of nuclear installations and of activities carried out there freely, using the necessary measurement and registration instruments, including audio and video recorders,

y. ANRA state inspectors enter service and industrial sites of nuclear installations freely,

z. In the order established in the RA legislation and the international agreements involving specialists from the RA ministries, other state authorities, entities as well as international organizations in regulatory practices.

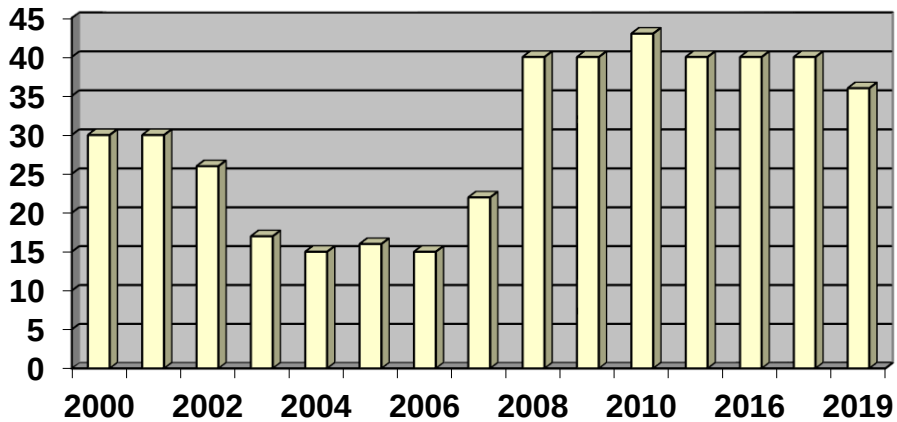
The organizational structure of ANRA is provided in Annex 5.

## ANRA Human Resources

ANRA staff list as of 01.01.2019 includes 45 positions. At present 37 out of 45 positions are occupied at the ANRA; 23 out of 37 are the professional staff, 5 out of 23 have PhD, 18 have more than 10 years' experience in the atomic energy utilization field and 6 out of those 18 have 5-years work experience at the Armenian NPP.

ANRA organizes training of new staff in accordance with the individual programs consisting of theoretical (on the job self-training) and practical trainings. The resources of IAEA, US NRC and EC cooperation programs are used for implementation of separate tasks concerned with training, improvement and maintaining of the personnel qualification.

Dynamics of ANRA Staffing



ANRA is financed from the State Budget of the RA. The budget for 2019 is 323,043,400 Armenian Drams (AD) (approximately 678,941 USD), which is approximately for 65,074.800 million AD more than in 2016. 67,279.800 AD (approximately 141,401.0 USD) is intended for funding the technical support organization of ANRA – Nuclear and Radiation Safety Center.

To function effectively and to continually improve the regulatory performance ANRA has established a process oriented quality management system. ANRA QMS is represented in the management handbook. ANRA QMS is a set of interrelated or interacting processes that establish policies and objectives and which enables those objectives to be achieved in safe, efficient and effective manner. ANRA QMS has been revised and brought in compliance with the IAEA GS-R-3 in accordance with the recommendations of the IRRS mission. ANRA plans to make another revision of its QMS for bringing in compliance with the GSR part 2.

To improve safety and physical protection of nuclear installations and nuclear materials, to promote non-proliferation and to prevent illicit trafficking of nuclear materials ANRA cooperates with the international organizations and regulatory authorities of other countries.

ANRA has cooperation agreements with the following regulatory authorities:

- United States Nuclear Regulatory Commission (US NRC) in frame of the Arrangement between the Nuclear Regulatory Authority of the Republic of Armenia and The United States Nuclear Regulatory Commission on the Exchange of Technical Information and Cooperation in Nuclear Safety Matters (signed on 27 March 2017);
- Rostekhnadzor in frame of the Agreement between the Federal Authority of Russia on Nuclear and Radiation Safety and the State Authority of Armenia on Nuclear and Radiation Safety (23 May 1994);
- Department of Nuclear and Radiation Safety of the Ministry of Emergency Situations of the Belarus Republic in frame of the agreement between the Government of the Republic of Armenia and the Government of the Republic of Belarus on cooperation for exchange of information and on nuclear safety and radiation protection (signed in May 2012);
- State Nuclear Regulatory Inspectorate of Ukraine and Armenian Nuclear Regulatory Authority in frame of the agreement between on cooperation in the fields of nuclear safety and radiation protection (signed on 26 October 2016).

In frame of EC INSC, IAEA technical cooperation projects ANRA cooperates with:

- Bel V, (a subsidiary of the Federal Agency for Nuclear Control), Belgium;
- Bulgarian Nuclear Regulatory Authority (BNRA), Bulgaria;
- Gesellschaft für Anlagen- und Reaktorsicherheit (GRS), Germany;
- Institut de Radioprotection et de Sûreté Nucléaire (IRSN), France;
- Nuclear Research Institute Řež plc (NRI Řež), Czech Republic;
- Radiation and Nuclear Safety Authority of Finland (STUK);
- Slovak Nuclear Regulatory Authority (UJD SR);
- State Office for Nuclear Safety (SUJB), Czech Republic.
- And other.

ANRA has no advisory committees. The Nuclear Energy Safety Council under the RA Prime Minister (former the Nuclear Energy Safety Council under the RA President) in accordance with its statute approved under the RA Prime Minister decree №1164-A as of September 3, 2018:

- Makes proposals on safety and safety improvement in the nuclear energy field;

- Makes analysis and proposals on measures aimed to improve the safety and reliability of Armenian NPP operation.

The Council implements its activities through meetings organized once a year or once in a year and a half is composed of world authorities in nuclear science and engineering.

The state republican authorities are the ministries of the RA, state authorities under the RA Government. The RA Government structure and the position of ANRA within the structure are provided in the Annex 4.

In accordance with the Article 17 (j) and its statute ANRA submits annual report to the RA Government on nuclear and radiation safety of the RA, its certain territories and nuclear installations.

Thus, the regulatory authority for nuclear safety regulation has been established at the RA; it is provided with relevant jurisdictions, human and financial resources and there is an effective separation between the functions of ANRA from the agencies responsible for promotion of nuclear energy.

Technical support to ANRA is provided by the Nuclear and Radiation Safety Center (NRSC), which is a scientific and technical company established under the Government Decree №342 as of April 25, 2001.

NRSC hires staff on the contractual basis and currently employs about 30 specialists (with an average age of 35 years), including:

- PhD holders - 7;
- PhD students – 1;
- Engineers & physicists - 15;
- IT specialists - 3;
- Management & Administration - 7.

NRSC provides technical and expert support to ANRA in the following areas:

- Expertise of design changes and safety justifications in frame of licensing of the Armenian NPP safety upgrades;
- Technical review of the revised SAR of Armenian NPP Unit №2 and safety assessments performed in framework of Armenian NPP lifetime extension;
- Technical review of the safety analysis report of the spent fuel storage facility;
- Technical support to licensing of ionizing radiation sources;
- Technical support to inspection activities in nuclear installations, ionizing radiation sources, radioactive waste storage and disposal facilities;
- Development of draft regulations related to the nuclear and radiation safety, radioactive waste management;
- Development and application of analytical models (including the PSA Level 1 models) for safety analyses and application of models to support the regulatory decision making process;
- Development of procedures for ANRA ERC activation and operation and involvement in the emergency response teams of ANRA;
- Participation in regulatory actions for strengthening control over radiation sources according to the IAEA recommendations.

The technical and expert support of the NRSC allows ANRA to make decision on nuclear and radiation safety regulation with better quality and in a timely manner. With NRSC's support, ANRA

organizes training and retraining of its personnel, including on-the-job training and training in the international courses.

### 3.2 STATUS OF THE REGULATORY BODY

The position of ANRA in the RA government structure is demonstrated in the Annex 4. The organizational structure of ANRA is provided in Annex 5. The information on status, jurisdictions, responsibilities, reporting obligations of ANRA is provided in the section 3.1- Establishment of the Regulatory Body.

## 4 RESPONSIBILITY OF LICENCE HOLDER

***Article 9. Responsibility of the Licence Holder***

***Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.***

In accordance with the Article 19, paragraph 2 of the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes and the Statute (point 1.2.1.6) of the Armenian NPP the prime responsibility for safe operation of safety important installation rests with the operating organization.

In accordance with the Article 20 of the Law the operating organization:

a. Develops and implements safety measures in the atomic energy utilisation object;
b. Ensures that a safety culture is maintained;
c. In the manner prescribed periodically submits reports on the safety of the facility to the regulatory authority;
d. Ensures that nuclear, radioactive and special materials, special equipment and technologies are put to useful purposes;
e. Ensures the physical protection of atomic energy utilisation installation, nuclear, radioactive and special materials, special equipment and technologies;
f. Develops the quality assurance programme for each stage in the lifetime of the atomic energy utilisation installation (site selection, design, construction, commissioning, operation, decommissioning) and ensures its implementation;
g. Organises the control of dose limits amongst personnel in the manner prescribed;
h. Organises the accounting and control of nuclear, radioactive and special materials and radioactive waste;
i. Organises and conducts investigations in the manner prescribed into incidents and accidents occurring during the operation of atomic energy utilisation installations;
j. In the manner prescribed develops the response plan for emergencies occurring in the atomic energy utilisation installation and ensures the preparedness of personnel and the necessary resources for its implementation;
k. Develops the programme of activities for protection against fire in the atomic energy utilisation installation and ensures its implementation;
l. Organises the recruitment and training of skilled personnel to work in the atomic energy utilisation object, or with nuclear and radioactive materials;
m. Ensures that the health and social conditions governing the personnel of the atomic energy utilisation installation are in accordance with the current regulations;

n. Carries out periodical safety assessments of the installation to ascertain its compatibility with the most recent safety requirements;

o. Performs other authorities determined by this Law and other legislative and legal acts of the Republic of Armenia.

The operating organisation of the atomic energy utilisation installation carries out the following tasks important in terms of safety:

a. Establishes the services that control the nuclear and radiation safety;

b. Organises the permanent control over the radiation situation in the controlled and supervised areas of the atomic energy utilisation installation;

c. Provides periodically the governor (mayor of Yerevan) of the territory included in the supervised area of the atomic energy utilisation installation with information in the established order on the radiation situation in the supervised area.

The ANRA ensures that the operator discharges its prime responsibility for safety by establishment of safety requirements and regulations, inspections and assessment, control over compliance with the legislation as well as with the licence terms and conditions, and imposing enforcement actions and in case of detecting violation of licence terms and conditions up to suspension and termination of license.

# 5 PRIORITY TO SAFETY

***Article 10 Priority to Safety***

***Each Contracting Party shall take the appropriate steps to ensure that all organizations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.***

In accordance with the Article 5 of the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes, the RA shall implement such a policy in the atomic energy utilization field where priority is given to safety. In accordance with the Article 19, paragraph 2 of the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes and the Statute of Armenian NPP the prime responsibility for safe operation of Armenian NPP rests with the operating organization.

The Nuclear Energy Safety Council under the Prime Minister of the Republic of Armenia (former Nuclear Energy Safety Council under the President of the Republic of Armenia) has been established to advice on the safety improvement of Armenian NPP.

Realizing the role and responsibility of the operating organization for safety, in 2004 Armenian NPP management adopted the declaration on safety policy and quality, where the priority to safety is expressed as follows: “The highest priority of our activity, dominating even the factor of production itself, is the safety of the Armenian NPP and the personnel…”

Armenian NPP safety management authorities are as follows:

- Armenian NPP safety council;
- Armenian NPP committee on personnel qualification and training;
- Armenian NPP scientific and technical council;
- Armenian NPP emergencies committee;
- ALARA committee;
- Committee on investigation of failures, accidents, and events (dedicated committees on identification of failure causes and development of compensating measures).

Armenian NPP Safety Council is a permanent authority reporting to Armenian NPP General Director. It reviews the most important and strategic issues related to Armenian NPP safety and operation.

Armenian NPP committee on personnel qualification and training specifies Armenian NPP policy in personnel training and makes decisions in this area.

Armenian NPP scientific and technical council (STC) is a permanent authority reporting to Armenian NPP General Director. The STC reviews and makes decisions on Armenian NPP technical policy and strategic planning of technical issues.

Armenian NPP emergency committee is a coordinating authority of Armenian NPP emergency response system and is aimed at organization and implementation of actions for management and mitigation of accident consequences.

ALARA committee reviews the most important issues related to optimization of radiation protection and maintaining both individual and collective dose rates at as low as reasonably achievable level.

The following activities are implemented in order to maintain proper level of safety culture at Armenian NPP:

- Continuous popularization of safety priority including regular training of different category managers and personnel to principles and characteristics of safety culture, ways and methods for improving the existing level of safety culture;
- Self-assessments of safety culture in departments and in the organization in whole;
- Development and implementation of corrective actions for improving the safety culture based on results of implemented self-assessments, and also international missions and peer reviews;
- Invitation of WANO support expert mission for leadership.

To enhance the safety culture the Armenian NPP periodically performs self-assessments of the safety culture and the safety management system. Such self-assessments are performed once in three years in accordance with the approved guideline on self-assessment:

- Guideline on Periodic Internal Safety Reviews and Analyses,
- Guideline on Self-Assessment of Safety and Reliability Management,
- Guideline on Operations Management System,
- Guideline on Self-Assessment of Safety Culture and Efficiency of Safety Management System,
- Guideline on Internal Commission Review of Armenian NPP Nuclear Safety.

In compliance with the requirements of the guideline on operations management systems in 2017 the self-assessments were performed.

In compliance with the requirements of the Guideline on Self-Assessment of Safety Culture and Efficiency of Safety Management System in 2017 the self-assessment of the organization safety culture was performed.

The self-assessment activities have been carried out since 2010. Based on the Guideline on Internal Commission Review of Armenian NPP Nuclear Safety in the IV quarter of 2014 a working program was developed for review of nuclear safety by the internal committee. The review was performed in 2015. The results were submitted at the meeting of Armenian NPP Safety Council and the Order of the General Director was issued on implementation of the decisions approved by the Safety Council.

In 2017 WANO MC performed Peer Review (PR) at Armenian NPP in the following areas of productive activity and company’s activity on a whole, respectively:

- Management organization and administration;
- Operations;
- Maintenance;

- Technical support;
- Radiation protection;
- Operating experience feedback;
- Chemistry;
- Personnel training and qualification;
- Fire protection;
- Emergency preparedness.
- Implementation of SOER recommendations.

Based on the results of the mission the corrective actions were developed and agreed with the management of WANO MC, and are implemented in compliance with the established terms.

ANRA has developed the "Guidelines for Regulatory Oversight of Safety Culture in Licensees' Organizations" which is in the stage of approval. In development of this guidance ANRA used international experience. The guidance contains all necessary information to allow ANRA perform systematic programme of overseeing licensee's safety culture, including during inspection.

# 6 FINANCIAL AND HUMAN RESOURCES

***Article 11 Financial and human resources***

1. ***Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.***
2. ***Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.***

## 6.1 FINANCIAL RESOURCES

In accordance with the Article 19[1] of the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes the operating organization from consumption of energy (services rendered) shall allocate financial resources for nuclear, radiation, and technical safety, fire protection, physical protection, nuclear material account and control, implementation of safety upgrades, scientific and technical support, as well as securities needed for storage of spent nuclear fuel and for decommissioning. The financial securities for decommissioning of nuclear installations are accumulated on a special account of the Ministry of Finance the RA. The use of these financial means in other purposes is prohibited. The RA Government adopted a decree №1637-N as of 12 October 2006 on opening a special account for decommissioning of the Armenian NPP that establishes the procedure of servicing and transfer of amounts to the account and reporting.

The safety upgrades are financed also from the own resources of Armenia, as well as under EC, RF, Czech Republic and US DOE assistance programs.

## 6.2 HUMAN RESOURCES

Selection, training, examination and permit to work of Armenian NPP personnel are arranged in compliance with the "Administrative Control Program. Armenian NPP personnel development".

Armenian NPP has established internal procedures addressing selection, training, probation and qualification of personnel based on the relevant IAEA documents.

The list of positions implementing safety important activities has been established by the RA Government. Qualification of persons holding position included into this list is checked by ANRA in compliance with the procedure established under the RA Government Decree № 768 as of 22.12.1999 on approval of the list of activities and positions of authority important for safety in atomic energy utilization.

In frame of IAEA and US DOE projects on providing assistance to the Armenian NPP, activities on implementation of systematic approach to training (SAT) are performed; and guidelines, regulations and procedures were developed and implemented for this purpose. These documents describe methods of developing training materials and conduct of training.

Analysis of the requirements to knowledge and training is based on the method of analyzing specifics of work and tasks of certain positions and of Armenian NPP on the whole.

Training and maintaining qualification of Armenian NPP personnel are conducted in accordance with the approved standard and individual programs which specify types of training and sequence, as well as the simulator training (the need for simulator training is established in the training program).

The centralized general training, theoretical training during primary training, maintaining qualification and training on simulator are conducted in the Training Center of the Armenian NPP.

The process modes simulated on multifunctional simulator (MFS) correspond to the operating modes of Armenian NPP Unit №2. The scope of the Armenian NPP operation modes simulated on MFS enables to ensure the MCR personnel training and qualification maintaining.

In case of modifications to Armenian NPP Unit №2 (installation of new equipment) during annual outage and refueling and etc., the similar changes are made also to the multifunctional simulator in order to bring it in line with Armenian NPP Unit №2 configuration.

At present, a full-scope simulator from Bohunice NPP (Slovakia) is installed at the Armenian NPP with adaptation to the operating Armenian NPP Unit №2 (reactor part).

Under US DOE support activities, the development of the emergency operating procedures, severe accident management guidelines are initiated and performed with their further validation on multifunctional simulator and full-scope simulator (after putting full-scope simulator into operation). The experts of US DOE group perform appropriate training with the Armenian NPP and contractor personnel involved in the mentioned activities.

According to the work plan on improvement of Armenian NPP personnel training system and under US DOE and IAEA assistance projects, regular training (theoretical part) activities for maintenance personnel and engineering technical personnel are implemented at the NPP training center. The practical training of the mentioned personnel is performed in the work places of the relevant structural departments.

The training programmes are periodically revised and corrected taking into account training analysis, feedback of departments, comments and suggestions of trainees.

The “Self-assessment of personnel training system efficiency” and the “Needs analysis for personnel training system improvement” have been performed at Armenian NPP. According to the results of activities performed, the appropriate recommendations and action plans for their implementation were developed, including the training programme improvement.

Information of IAEA, WANO, Armenian NPP and other information systems in relation to operational events is carefully studied and covered in the training programs of Armenian NPP personnel.

Training of the relevant Armenian NPP personnel on modernization of equipment, system and activities performed during outages is implemented.

The sufficiency of Armenian NPP personnel is established by the standard number and the staff list (to be approved by the Board of Directors) taking into account the scope and complexity of the servicing equipment that ensure the NPP safe operation, as well as by the regular leaves provided to

employees and the time allocated to training. The method of personnel number redundancy is additionally applied for positions important from the safety point of view.

The nuclear safety related activities are performed by Armenian NPP personnel authorized to perform these types of activities. Specific activities related to nuclear safety are performed by organizations involved in implementation of the nuclear safety related practices and having certificates accepted by ANRA. The personnel trained according to the developed and approved procedures perform all activities.

Qualification of the contractor personnel is examined before the contract is concluded according to the service purchase procedure.

Armenian NPP is not responsible for the contractor personnel training. However, the contractors' personnel, if needed, participate in workshops or training courses implemented at Armenian NPP in order to perform certain activities at Armenian NPP in the established order.

ANRA performs inspections to verify the sufficiency of human resources at the Armenian NPP in accordance with the inspection program.

Based on the inspections results ANRA develops the report indicating the results of inspection, identified deficiencies and the date of their elimination and transmits it to Armenian NPP.

Armenian NPP in the established order informs ANRA about measures undertaken to eliminate deficiencies identified during the regulatory inspections.

# 7 HUMAN FACTORS

### *Article 12. Human Factors*

***Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.***

The design of any modification takes into account the human factor with implementation of the "Operator non-interference" principle. The operators will not be able to interfere in the software operation within 10 minutes after violation of normal operation condition of the new system. In 10 minutes these systems provide the operators with information on possible and allowed actions.

All activities on the safety systems are implemented in accordance with the programs approved by the Armenian NPP Chief Engineer.

The functions connected with human and organizational factors management in the operating organization are distributed among the divisions. In particular, the aspects concerned with investigation and analysis of event connected with the human and organizational factors are assigned to the Operating Experience Department, the aspects connected with the organizational factor management are assigned to the Quality Assurance Department, training aspects and activity motivation are assigned to the Training Center, and aspects connected with the "man-machine" interface are assigned to the Engineering Support Department.

The whole activity in the above mentioned areas is aimed at improvement of the procedures taking into account the human factor, improvement of issues concerned with ergonomics and the "man-machine" interface and improvement of personnel activity with application of different means for error reduction on the level of doer, manager and organization.

Analysis of the events connected with human activity and organizational factors, shows the following main typical causes of errors:

- Incorrect, non-appropriate implementation of technological operations (errors at making switches);

- Uncoordinated actions;
- Deviation from work programs, procedures and other documents;
- Poor maintenance, violation of maintenance technology;
- Poor assembling (unreliable tightening, reduction of detachable parts, sealing);
- Deficiencies in information exchange and records keeping on the work results.
- The self-assessment program that covers various levels of organization is implemented for assessment of managerial and organizational issues at Armenian NPP.

The program envisages implementation of regular self – assessments on:

- Corporate level;
- Level of separate areas of activity;
- Level of structural divisions;
- Individual level of personnel.

The purpose of self-assessments on different levels is to determine the effectiveness of the management system on the given level, to detect deficiencies connected with managerial and organizational issues, as well as to comply with requirements of the international standards and good practices.

The standard guideline on organization and performance of self-assessments was developed to ensure the structural approach to self-assessments in different areas of activities and in different divisions. By now, self-assessments of the personnel training system, maintenance and repair, radiation safety and of the activity of the maintenance planning and implementation department have been performed.

ANRA implements the regulatory control over human factor and associated organizational measures of the operating organization through inspections. In case of events important to safety ANRA within its jurisdictions when necessary conducts independent investigation, detects root causes of personnel errors, impose enforcement actions.

At review and granting permission on modification ANRA verifies availability of systematic ergonomic analysis of this modification from the point of view of safety, reliability and usefulness for Armenian NPP, and also preparedness of the personnel to operate under new conditions.

# 8 QUALITY ASSURANCE

### *Article 13 Quality Assurance*

***Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmers are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.***

The Quality Assurance Program (QAP) of Armenian NPP was developed in accordance with the requirements of IAEA (Safety Series №50-C/SG-Q "Quality assurance for safety in Nuclear Power Plants and Other Nuclear Installations"); it was approved in 2004 and then revised in the established order.

The present QAP is developed for Armenian NPP operation and covers the whole activity of the Armenian NPP. QAP summarizes the management processes for 30 areas of activities and references. More detailed descriptions of the management processes on the level of sub-processes are provided in the guidelines. Thus, the administrative management program with its set of guidelines for a

specific activity provides a detailed and complete description of a process, including distribution of responsibilities of personnel and divisions.

A number of documents included in the management system have been developed and implemented over the last years at Armenian NPP. The documents cover all safety aspects, such as nuclear safety, radiation safety, industrial safety, fire protection and seismic safety, as well as system of management and control of works performed by the Contractor.

With the aim of upgrading the existing system up to the integrated one the processes of some activity areas management were reviewed in the reported period and, based on the existing documentation on the quality management system, the missing documents related to labor protection and also physical protection and regime activities were developed.

In accordance with the RA Government Decree №461-N as of April 19, 2012 and the RA Government Decree №1085-N as of August 23, 2012 the "QAP for Armenian NPP Unit №2 lifetime extension" was developed to ensure the quality of measures on preparation to Armenian NPP operation lifetime extension.

Besides, Armenian NPP has a Quality Audit Program for systematic assessment of all types of activities. The Audit Program includes a document specifying requirements to organization and conduct of quality audits, training of auditors, as well as a three-year audit schedule, which is to be annually revised. The schedule contains tentative dates of audit for three years and includes audit of works and services of suppliers. Such approach allows ensuring auditing every field of activity important to safety at least once in 3-4 years. With this, unscheduled quality audits are foreseen at a separate request of the top management of Armenian NPP.

As a result of quality audits, corrective measures are developed with further control over their implementation by the responsible persons.

Armenian NPP, using the relevant IAEA documents, has developed guidelines that establish the types, methods, as well as the procedure for conducting audits of quality system of vendors of equipment, materials, activities (including nuclear and radiation hazardous) and services. Quality audits are the planned activities of Armenian NPP. The purpose of the audits of vendors is to guarantee that only those vendors are allowed to make supplies to Armenian NPP, whose capability to ensure that products meet the established requirements is verified, objectively proven, documented and controlled. In addition, a dedicated organization was involved in assessing the conformity of products with the established requirements within the framework of the LTO project.

For the regulatory control over the quality assurance of Armenian NPP ANRA:

- Conducts planned and reactive inspections;
- Identifies the QA condition and dynamics of its change;
- Verifies and assesses the preparedness of personnel and understanding of the quality policy adopted by the personnel;
- Verifies availability and quality of the QA programs;
- Assesses measures for detection of inconsistencies and implementation of corrective measures;
- Analyses self-assessment reports of all levels and audit results;
- Makes independent assessment of effectiveness of the quality management system;
- Assesses measures aimed for the quality management system improvement and makes recommendations and proposals;
- Imposes enforcement actions when deficiencies are detected and identifies deadlines for elimination of those deficiencies and controls over the implementation.

# 9 ASSESSMENT AND VERIFICATION OF SAFETY

***Article 14 Assessment and Verification of Safety***

***Each Contracting Party shall take the appropriate steps to ensure that:***

> ***(i) comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;***
>
> ***(ii) verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.***

## 9.1 ASSESSMENT OF SAFETY

The Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes establishes, in particular:

- Commitments and responsibilities of the operating organization to submit to the regulatory authority the annual reports on current safety state of the unit and its compliance with the existing in the RA rules and standards;
- Commitments and responsibilities of the operating organizations to submit periodical safety assessments and analysis on safety state of the unit with respect to its compliance with the newly adopted regulatory rules and standards.

The Law of the RA on Licensing establishes types of practices subject to licensing in the atomic energy utilization field. The licensing procedures establishing rights, responsibilities, order, content and form of application documents supporting documents for obtaining a license for a specific practice (see Annex 2) have been adopted under the RA Government decrees.

At present in accordance with the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes and the legal acts the NPP licensing consists of 5 stages:

- Site selection;
- Design;
- Construction;
- Operation;
- Decommissioning.

On the stage of licensing of site selection in accordance with the RA Government Decree № 609-N as of 12.05.2005 the operating organization, among the others, should submit the following documentation in support to the licence application:

- General description of the design of the facility to be constructed on the particular site;
- The quality assurance program of the site selection for the facility;
- Results of public hearing in relation to the site selection for the facility.

The list of organizations involved in the site selection, copies of their statutes and information on necessary professional qualifications of personnel for site selection of applicant and those organizations, and the documents certifying the availability of technical means and software

On the stage of licensing of NPP construction in accordance with the RA Government Decree № 649-N as of 12.05.2005 the operating organization among the others should submit the following documentation in support to the licence application:

- General design of nuclear installation;
- Design of nuclear installation being constructed;
- Preliminary safety analysis report;
- NPP environmental impact assessment report and conclusion;
- PSA Report;
- Results of public hearing.

On the stage of licensing of NPP operation in accordance with the RA Government Decree № 400-N as of 24.03.2005 the operating organization should among the others submit the following documentation in support to the licence application:

- Final safety analysis report;
- PSA report;
- Technical specification specification for operation of nuclear installation;
- Safety systems classification;
- Emergency response plan;
- Technological specification and instruction on NPP systems operation;
- Plan of fire protection measures.

On the stage of licensing of NPP decommissioning the RA Government Decree № 707-N as of 01.06.2005 the operating organization should among the others submit the following documentation in support to the licence application:

- Decommissioning program;
- Safety analysis report at NPP decommissioning;
- Program on management of radioactive wastes generated during decommissioning of nuclear installation;
- Plan on emergency response at decommissioning.

In connection with the Law on Construction of New NPP Unit(s) in the RA, measures are undertaken for updating the above mentioned regulations and guides with the purpose to harmonize them with the modern approaches and IAEA Safety Standards applied in this area. In particular, the following regulations were updated in 2016-2019 taking into account the lessons learned from the Fukushima accident and LTO:

- Government Decree № 2013-N as of 21.11.2002 on approval of the requirements to form and contents of the Safety Analysis Report of the Armenian NPP Unit №2;
- Government Decree № 400-N as of 24.03.2005 on approval of the licensing procedure and licence form for operation of nuclear installations;
- Government Decree № 1085-N as of 23.08.2012 on approval of the requirements to extension of design lifetime for Armenian NPP Unit №2 operation.

Based on operation licence condition, licensee should submit annual report on safety assessment of the unit.

After adoption of the RA Government Decree on the Armenian NPP restart in 1993, a comprehensive safety review with involvement of foreign and Armenian experts was undertaken aimed at identifying

design and operational weaknesses. A new set of deterministic analyses were performed. Experts from IAEA, EC and USA participated in engineering assessment for detection of deficiencies in the design safety of Armenian NPP unit № 2. Based on the assessment results the program of measures aimed at improving Armenian NPP Unit №2 safety, reliability and safety culture was developed for elimination of deficiencies by priorities in the below mentioned sequence:

- Highly important, strictly scheduled as conditions of the operational license;
- Important, but not connected to the operational license;
- Others, necessary to be implemented but not strictly scheduled.

The program was approved by the Ministry of Energy of the RA (at present the Ministry of Territorial Administration and Infrastructure) and agreed with ANRA.

ANRA reviewed the requirements to the contents and format of Armenian NPP Unit №2 SAR enforced under the RA Government Decree № 2013-N as of November 21, 2001, taking into account IAEA GS-G-4.1 guide.

ANRA/NRSC started development of the requirements to contents and format of Armenian NPP Unit №2 PSR report. In accordance with the requirements Armenian NPP will develop the PSR report for license renewal.

In the period 2004-2006 the specialists of NRSC and Armenian NPP developed a new revision of improved and detailed PSA model in accordance with the international standards (based on IAEA and US NRC regulations). The scope of the existing PSA model includes:

- Internal initiating events;
- Regimes with both turbines in operation;
- Reactor core damage is considered as an undesired event.

Then, the seismic hazard was also integrated in the 2$^{nd}$ iteration of PSA model. Recently the 3$^{rd}$ iteration of seismic hazard was integrated in the model which was performed by the Risk Engineering Company (Bulgaria).

In 2007 IAEA IPSART mission and Risk Engineering Company (Bulgaria) performed expertise of the internal initiating events in the PSA model. Besides, the internal PSA review was made by NRSC.

Recent activities in this field were aimed to resolve comments made by the external (IPSART+Risk Engineering) and internal (NRSC) reviews. All mentioned comments have been addressed in 3$^{rd}$ iteration of PSA model and associated documentation.

In 2014 IAEA IPSART mission was organized to review and comment on the improved 3$^{rd}$ iteration of PSA model and associated documentation. The mission scope covered internal initiating events, external initiating events, internal fires and seismic PSA, as well as not completed low power and shutdown PSA.

PSA has been reviewed with support of the ANL experts in frame of technical assistance provided by the US DOE. PSA is brought in compliance with the situation for the end of 2012. The model incorporates capabilities for transition to PSA Level 2. The detailed analysis of all human errors probability factors have been performed to include the risk-informed decision making in the model. Additional thermal hydraulic calculations have been performed with the purpose to calculate the success criteria. PSA review has been completed and transmitted to NRSC for expertise. In accordance with the calculation the core damage frequency factor is 5.28E-05 1/year (before the review the core damage frequency factor was 7.58E-05 1/year). Contributions to the core damage from different initiating events became more realistic which allows application of PSA for the risk-informed decision making.

The development of PSA in the hot zero power operation and in the shutdown condition has been initiated. In 2014 approximately 60% of the work has been performed. IPSART mission comments

and recommendation are considered. The latest version of the study considered the comments and recommendations from IPSART mission.

After the Fukushima accident Armenian NPP together with NRSC launched a project with IAEA aimed to apply the fault sequence analysis (FSA) method for Armenian NPP. The main objective of the project is to perform a complementary analysis of the plant robustness by assessing potential impact of external hazards and their credible combinations using the FSA method and the software Fault Sequence Tool for Extreme Events (FAST-EE) developed by IAEA.

Fire PSA was performed by the NRSC during 2011-2013, which was updated based on the review results of IPSART mission in 2016. According to the updated fire PSA quantification results fire induced CDF equals 9.34E-06 [1/y]. Risk profile analysis shows that 10 out of 112 fire zones contributes 95% of overall fire-induced CDF. Main risk contributors are following fire zones:

- Switchgear (E105 and E119);
- Confinement (AO-004);
- Intermediate relay compartment E-314/2;
- Turbine Hall;
- Main control room.

The external hazards risk integration in 3rd iteration PSA model was completed in the quarter 4 of 2016. Total CDF due to external effects is 5.47E-06 1/year.

The current status of PSA models and the results for the Armenian NPP are provided in the Table 1.

Table 1. PSA models status and results.

| № | PSA type | CDF [1/y] |
|---|---|---|
| 1 | Internal initiating events | 5.28E-05 |
| 2 | Internal fires | 9.34E-06 |
| 3 | Seismic | 1.39E-05 |
| 4 | External initiating events (except for seismic) | 5.47E-06 |

The calculations were performed for the accidents included in the list of design basis and beyond design basis accidents.

In 2016 at the request of ANRA NRSC performed the comprehensive safety study of the ANPP Spent Fuel Pool (SFP), which includes SFP PSA. According to SFP PSA quantification results, the mean values of total FD frequencies (due to fuel uncovery) of the Unit №1 SFP and Unit №2 SFP for all considered operational conditions are 5.74E-07 [1/y] and 7.71E-05 [1/y], respectively. This study identified that the mechanical damage of the Unit №1 SFP and Unit №2 SFP fuel can be observed with the frequencies 3.26E-05 [1/y] and 3.67E-05 [1/y], respectively.

Risk quantification of the Unit №1 SFP showed that the accidents with loss of coolant to the confinement and out of the confinement contribute 98.3 % to the overall FD due to uncovery of the Unit №1 SFP fuel. The rest IEs have insignificant contribution.

Risk quantification of the Unit №2 SFP showed that the human-induced LOCA contributes 99.2 % to the overall FD due to uncovery of the Unit №2 SFP fuel. The next contributors are loss of coolant from Unit №2 SFP to the confinement and loss of cooling of the Unit №2 SFP.

The contribution of the supporting systems is negligible compared to others. For the Unit №1 SFP and the Unit №2 SFP the frequencies of FD (due to uncovery) during the full power operation are 5.74E-07 [1/y] and 5.78E-07 [1/y], respectively.

Armenian NPP with IAEA support initiated a project to develop a Comprehensive Safety Upgrading Programme with regard to the safety goals and criteria, agreed with ANRA and including LOCA200

as design basis accident and address the safety issues identified at Armenian NPP by several IAEA missions and to provide solution for the unresolved issues of high ranking.

Based on the results of the Comprehensive Safety Upgrading Programme, a list of safety measures was developed for Armenian NPP.

In 2013 ÚJV Řež jointly with the NRSC performed assessment of selected scenarios with pressurized thermal shock for Armenian NPP Unit № 2 in frame of IAEA Project ARM/9/022.

The RA voluntarily jointed the initiative to perform the comprehensive risk and safety assessments ("stress tests"), taking into account the specifications agreed by the European Commission and the European Nuclear Safety Regulators Group (ENSREG) on May 24, 2011.

Following the nuclear accident at the Fukushima NPP on 11 March 2011, the Armenian Government emphasized the need for urgent actions to reassess the preparedness of Armenian NPP to respond to emergencies. In June 2011, ANRA required the Armenian NPP to perform in-depth reassessment of Armenian NPP safety in light of the Fukushima accident (stress-tests), which should be in conformity with the methodology adopted by ENSREG and EC.

In this initiative Armenian NPP was supported by EC under the dedicated project to implement the self-assessment and prepare the report. Armenian NPP self-assessment covered the Unit №2 and the wet spent fuel pools of the Unit №1 and the Unit №2. The plant data and re-assessment provided in report are as of July 2012.

The national stress-test report has been prepared on the basis of self-assessment report of Armenian NPP. The first part of the report provides the main data for the site and Armenian NPP with special emphasis being made on its characteristics. The design bases of Armenian NPP, reassessment of safety margins and cliff edge effects are provided in the chapters 2-6; each chapter summarizes the proposed measures to improve the plant robustness to extreme natural phenomena. In the chapter 7 conclusions and recommendations are summarized. The national stress-test report has been sent to ENSREG group in August 2015. The EC peer review was performed on 20-24 June 2016 in Yerevan, Armenia. The recommendation of the EC experts to the Armenian NPP "stress test" are summarized the PRT report.

Post Fukushima National Action Plan (NAcP) on Strengthening of Nuclear Safety of Armenian Nuclear Power Plant follows the National Report on the stress tests of Armenian NPP.

NAcP on Strengthening Nuclear Safety of Armenian NPP contains a compilation of all the major conclusions and recommendations contained in the National Stress Tests Report of Armenia, the report from the peer review process by ENSREG group, the Final Summary Report of the 2nd Extraordinary Meeting of the Contracting Parties to the Convention on Nuclear safety. NAcP is structured, in accordance with the structure suggested by ENSREG, into four parts. Part I deals with the external hazards issues (earthquakes, floods, extreme weather conditions), the loss of safety systems and severe accident management. Part II deals with the national organization, the organization of emergency preparedness and emergency response, and international cooperation, as were evaluated at an extraordinary meeting of the Convention on Nuclear Safety. Part III contains the list of measures aimed in implementing all the recommendations contained in parts I – II. The set of these measures is the sum of findings identified in the stress tests after the Fukushima accident.

NAcP was submitted to ENSREG in 2017. Armenian NPP reports about implementation of activities included in NAcP twice a year to ANRA.

In 2017 the methodology for performing radiological consequence analysis for DBA was enforced under the RA Government Decree № N52 as of December 17, 2017. At present, this methodology is used for justification of the spray system modernization.

New equipment qualification requirements were enforced by ANRA in 2017. Based on these requirements in 2018 Armenian NPP started development of the equipment qualification program.

In frame of LTE in 2018 ANRA updated requirements to SAR approved under the RA Government Decree. Armenian NPP within the LTE project has started to update SAR according to the updated requirements.

ANRA uses its TSO, i.e. the Nuclear and Radiation Safety Center, for assessment of certain aspects of Armenian NPP safety. In the reporting period the following activities were performed by NRSC for the regulatory decision-making:

- Hydrogen safety assessment in case of DBA and BDBA;
- Confinement behavior assessment during LOCA accidents;
- Certain aspects of DBA and BDBA analyses e.g. ECCS behavior during large LOCAs;
- Radiological consequence analysis;
- Development of the Maintenance Effectiveness Monitoring;
- External hazard combination analysis using the RiskSpectrum tool;
- Sump filter clogging analysis;
- PTS study;
- CCFL in fuel assembly investigation using CFD;
- Assessment in reactor head coolant cooling possibility by natural convection using CFD code;
- Assessment natural convection in spent fuel pool in case of station blackout;
- Validation of the PARCS transient model based on AER benchmark on recriticality in WWER-440 reactor core due to steam header break;
- Assessment of uncertainty in reactor core k-eff due to uncertainties in few-group macroscopic cross-sections;
- Development of risk-informed inspection planning guidance for ANRA;
- Deterministic and probabilistic assessment of the spent fuel pool safety.

In accordance with the RA Government Decree №1085-N as of August 23, 2012, the operating organization performs safety and resource assessment for the operation lifetime extension of Armenian NPP.

In accordance with the procedure on modifications, ANRA performs assessment and licensing of safety and safety important modifications.

## 9.2 VERIFICATION OF SAFETY

The main programmes used for verification of the state of Armenian NPP are:

- Periodic testing of the safety important systems according to the operational limits and conditions;
- Preventive and predictive maintenance programme;
- In-service inspection programme;
- Periodic inspections of the pressure equipment and piping;
- Surveillance programme of the reactor pressure vessel material;
- Programmes for evaluation of the components and materials ageing.

Activities for verification of the physical condition of Armenian NPP are performed in connection with normal daily routines and with scheduled inspections, testing, preventive maintenance etc. Detailed programmes and procedures are established and approved by the licensee. They are also reviewed and approved by ANRA. The results of tests and inspections are documented, provided to

ANRA and used through a feedback process for further activities. The operational limits and conditions are approved by ANRA.

To implement Armenian NPP policy in the field of ageing management and to fulfill the regulatory requirements to the ageing management, the "Aging Management Group" was established as part of the resource and operation extension department and the document "Ageing Management System for Ageing Systems, Structures and Components" was developed and implemented and international general lessons learned on ageing separate ageing management programs for specific (groups) of elements are developed.

To ensure effective management of the ageing of elements and structures at Armenian NPP with the support of IAEA, an AMS database of I&C Energo company (Czech Republic) was introduced, which provides input and processing of information on resource characteristics, on the results of the in-service inspection of the NPP equipment metal and special examinations, tests.

According to the terms and ccondition of the License №MTSH-002-2011 for operation of nuclear installations, Armenian NPP annually assesses the safety condition during the Unit № 2 operation over the past year. The corresponding "Annual report on assessment of safety condition during Armenian NPP unit №2 operation" is submitted to ANRA.

ANRA on regular basis performs assessment and control over the current level of Armenian NPP Unit №2 safety through:

- Annual reports on safety assessment of Armenian NPP Unit №2 operation;
- Regular inspections on assessment of the safety level in accordance with the annual schedule of ANRA;
- Regulatory review of safety cases submitted by Armenian NPP for licensing of safety modifications.

# 10 RADIATION PROTECTION

### *Article 15 Radiation Protection*

***Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.***

The list of legal acts that establish regulatory requirements to the radiation protection of nuclear installations is provided in Annex 2 of the national report.

The dose limits for workers and public established in the "Radiation safety norms" on the whole are in line with the requirements of GSR part 3.

The Chapter II of the "Radiation safety norms" specifies the requirements to implementation the optimization principle (ALARA).

According to the existing regulations for the new constructed NPPs the dose constraint shall not exceed 100 μSv/year.

Armenian NPP management adheres to the policy of indisputable safety priority over other concerns and considers the dose optimization principles as the most important means for decreasing the exposure of personnel working in conditions of ionizing radiation stated in "Armenian NPP management declaration about the policy in the area of radiation safety".

The objectives, criteria, procedures, administrative limitations on the radiation safety are set taking into consideration:

- Requirements of standard documents;
- International practice in the area of radiation safety;
- Available operational experience of Armenian NPP and other NPPs;
- Need for maximum possible decrease of NPP impact on environment.

The efficiency of the Armenian NPP radiation safety is evaluated with the following indicators:

- Maximum individual dose;
- Personnel collective dose;
- Amount of radioactive substances in airborne release;
- Amount of liquid radioactive substances in effluents;
- Amount of radioactive effluent;
- Number of personnel contamination cases;
- Number of radiation incidents subject to reporting.

The assessment of radiation safety efficiency requires consideration of the above mentioned indicators and corresponding standards ratio, dynamics of indicators, their comparison against similar values which specify radiation safety condition at other similar NPPs.

For practical implementation of the radiation protection optimization the ALARA Committee and the ALARA Engineering group were established at Armenian NPP. The ALARA Committee and the ALARA Engineering group work regularly in close cooperation with all departments of Armenian NPP involved in activities with ionizing radiation sources, and implement activity on the Armenian NPP radiation protection optimization according to the requirements of the program on the "Armenian NPP radiation protection management optimization according to ALARA principle".

Annual report is prepared based on the results of the ALARA Committee activity. The report makes a part of Armenian NPP industrial activity annual report.

With the purpose of further implementation of the ALARA principle, the Armenian NPP developed the Radiation Protection Program for 2018 which establishes the objectives and goals for minimizing radiation impact and ensuring effective radiation protection of the Armenian NPP personnel. The objective of ALARA principle is to maintain the annual personnel collective dose rate at as low as reasonably achievable level, in particular:

- Non-exceeding of annual personnel collective dose, 1.273 man*Sv;
- Non-exceeding of personnel collective dose during outage, 1012 man*mSv;
- Non-exceeding annual individual dose, 18 mSv;
- Maintaining radioactive gas and aerosol release value below the administrative levels:
  - Inert radioactive gas – $24*10^{12}$ Bq/year,
  - Long-lived nuclides – $46*10^{6}$ Bq/year,
  - Iodine – $14*10^{6}$ Bq/year;
- Maintaining the amount of radioactive effluent below the administrative levels - $\Sigma\beta act = 3,7$ Bq/l;
- Reducing the number of contaminated people.

Before the outage, measures were developed to ensure radiation safety and to optimize the personnel dose loads during the outage in 2018.

The individual external exposure is monitored once per month with the thermos-luminescence dosimeter (TLD).

To control the exposure dose on a shift basis, in addition to the TLD, the personnel has electronic dosimeters with built-in alarm, which activates when the threshold set both for the dose rate and the cumulative dose is exceeded. The personnel entry into the controlled area is allowed by the system only with both dosimeters. In case of approaching the dose limits set at the Armenian NPP, a failure to pass the test on radiation safety and negative results of medical examination, the system automatically prohibits the entry of the given employee into the controlled area.

The maximum individual internal exposure dose for Armenian NPP personnel from intake in lung is 0.01mSv. The collective and individual maximum dose trends at Armenian NPP are demonstrated on figures 1-2 of Annex 6.

During the scheduled outage of 2018 the planned external collective dose load of Armenian NPP personnel was 1012 man*mSv. The actual external collective dose of Armenian NPP personnel was 619,41. man*mSv.

In the reporting period:

- The maximum individual dose of external exposure is 12.127mSv;
- The annual collective dose for the Armenian NPP personnel is 854.29 man*mSv;
- The collective dose of outside workers is 210.351 man*mSv.

The majority of the personnel annual effective dose consists of the doses received by the personnel implementing radiation hazard operations during annual outage and refueling: non-destructive testing, decontamination works, repair works on systems and components. These activities are mainly performed by Armenian NPP personnel, and this explains the difference in doses received by the personnel and contractors.

## Airborne and liquid releases from Armenian NPP

The radiation monitoring is implemented in accordance with the "Technical specification on radiation monitoring of Armenian NPP", which specifies the conditions and limits of radioactive releases and effluents (source term).

The airborne releases from Armenian NPP are controlled by the measurement devices located on the ventilation stack (150m height), and the liquid effluents are controlled by taking samples from the bore-holes located outside of boundary of Armenian NPP rainwater and sewerage systems. The measurement frequency is described in the technical specification for radiation monitoring.

The annual allowable release of radioactive gases and airborne into the atmosphere and the control levels for release of radioactive gases and airborne into the atmosphere per month are demonstrated on the tables 1 and 2 of Annex 5.

The main contribution to releases is made by the following radionulcides $^{137}$Cs (4.46%), $^{134}$Cs (1.44%), $^{131}$I(30.96%), $^{110m}$Ag(18.18.0%), $^{106}$Ru(20.13%), $^{90}$Sr (0.11%), $^{60}$Co(18.6.%), $^{58}$Co (1.49%), $^{54}$Mn(0.34%) and $^{51}$Cr (4.29%) ) (See Figure 4 of Annex 5). The $^{60}$Co, $^{58}$Co,$^{110m}$Ag, $^{54}$Mn, are corrosion radionuclides and $^{137}$Cs, $^{131}$I and $^{90}$Sr fission radionuclides. The comparative analysis of values of radioactive releases into atmosphere in 2018 demonstrated that they are on the same level as last year and below average level for the whole operation period. The main contribution to the releases value is provided by radionuclide $^{137}$Cs, $^{60}$Co, $^{106}$Ru and $^{110m}$Ag (regardless of Radioactive Noble Gases).

The release of noble gases for 2018 was $1833.1*10^{6}$Bq (the permissible level is 690 TBq).

The expected increase of corrosion origin radionuclide releases during the outage was recorded. Occurrence of this radionuclide is conditioned by maintenance activities performed on primary circuit equipment.

It should be noted that the amount of releases and discharges from Armenian NPP is (for several tens of times) below the reference levels and allowable values, specified in "Sanitary Regulations for the Design and Operation of Nuclear Power Plants" (SP AES-03).

The annual releases of long-lived radionuclides are provided on Figure 3 of Annex 6.

The annual activities of liquid discharges from Armenian NPP are specified in Table 4 of Annex 6 and are below the authorized levels.

The low levels of releases from Armenian NPP are conditioned by the reliability of the first barriers of defense in depth.

At present, in the frame of Armenian NPP life time extension the measures are undertaken on modernization of the radiation monitoring system including the release control systems and the environmental radiation monitoring control system. The purpose of the modernization is to control and assess the dose loads for public.

## Environmental Radiation Impact from Armenian NPP

With the purpose of monitoring of Armenian NPP environmental radiation impact, the quantities of radioactive substances in the air, atmospheric precipitation, open waters, soil, vegetation, and locally produced food (agricultural plants, milk, etc.) in Armenian NPP supervised area (10 km radius) has been estimated.

The environmental radiation monitoring of facilities in Armenian NPP supervised area and methods of distribution of areas for taking samples are determined taking into account the climatic, geographic, economic, demographic and other factors of Armenian NPP location area.

The population external exposure control in Armenian NPP supervised area is performed by the regular dosimetric measurements in the supervised area. In accordance with the periodical measurements results the gamma dose rate in the supervised area (external exposure) varied within 0.08 μSv/hour - 0.12 μSv/hour (open areas), which is almost the same as mentioned in the report on radiation situation surveillance dated 1976 before Armenian NPP commissioning (0.1-0.12 μSv/hour).

On the territory of Armenian NPP the gamma dose rate in the reporting period was estimated to 0.10 - 0.63 μSv/hours.

The results of environmental radiation monitoring for 2018 are provided in tables 5-16 of Annex 6.

The comparative analysis of information obtained and the radiation data bank for the whole NPP operation period demonstrates that radiation situation in Armenian NPP surveillance area has not essentially changed. Concentration of radionuclide in all environment objects is for several orders below the rated values. Radiological situation in the surveillance area is normal, no marked deviations compared to the data for the whole period of operation (within measurement accuracy) were observed. Concentration of induced radionuclide ($^{137}Cs$, $^{90}Sr$) in the environment is conditioned by global fallouts. This conclusion was made based on the analysis of spatial distribution of these radionuclides in the environment objects.

The data provided in the present report demonstrate that the goals set in the Radiation Protection Program for 2018 have been reached in general except for insignificant increase of collective personnel dose of the reactor department, thermal instrumentation & control shop and department of engineering and technical means of physical protection.

## Regulatory review and control activities

The regulatory review and control activities cover the review of monthly and annual reports on radiation situation on the Armenian NPP site and its supervised area and on the results of inspections performed at the Armenian NPP covering the following topics:

- Implementation of radiation protection activities included in the program of Armenian NPP safety improvement measures;
- QA programme for the measures implemented in the controlled area;
- Limits and conditions of radiation protection and safety in accordance with the technical specification on radiation monitoring;
- Occupational radiation protection program and implementation of the ALARA principle;
- ALARA implementation measures during the airborne and liquid releases from the Armenian NPP into the environment and the system of environmental radiation monitoring and public dose control.

In the reporting period Armenian NPP individual maximum and collective dose values (see Figures 1, 2 of Annex 6) remain below the dose values specified in the standards and are considered acceptable.

In 2018 estimated the annual doses received for the Metsamor (located in 5 km from Armenian NPP) population critical groups (0-1 years, 1-2 years, 2 -7 years, 7-12 years and 12-17 years old children and adults) based on Armenian NPP releases and discharges, as well as the measurement results of the environmental samples. The calculations performed with RD software developed by VUJE are presented in Table 16 of Annex 6.

The data provided in Tables 5-16 of 6 Annex 6 indicate that the radioactive releases and discharges from Armenian NPP did not result in contamination of air, surrounding areas, land, water, algae, river depositions and contamination of vegetation and local food.

Though the winds blowing from the north-east-east sector prevail in Armenian NPP supervised area, which in case of higher releases could have led to radioactivity increase in the control points distributed in the relevant sectors, the environmental sampling data demonstrate that the radiation characteristics (dose rates, radioactivity concentration, surface contamination) in all territories of the Armenian NPP supervised area differ from each other within the allowable error rate of the measurements. The comparison of the measurements data with the ones made before the Armenian NPP operation ("zero-background measurement") demonstrate that the Armenian NPP operation have not led to the environmental contamination.

# 11 EMERGENCY PREPAREDNESS

***Article 16. Emergency preparedness***

1. ***Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover***

   ***the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.***

2. ***Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.***

3. ***Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.***

## 11.1 EMERGENCY PLANS AND PROGRAMS

The main legal acts settling the relations concerned with response to nuclear and radiological emergencies are:

- Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes;
- Law of the RA on Population Protection during Emergencies;
- President Ordinance № NK-231-A as of November 17, 2016 on the approval of the strategy for ensuring the biological, chemical and radiological safety of the Republic of Armenia;
- RA Government Decree № 259-A as of March 19, 2015 on approval of the program-schedule for the implementation of measures to ensure the functioning of the population notification system of preventive protective actions zones and urgent protective planning actions zones in case of a threat or radiological or nuclear accident at Armenian NPP;
- Population Protection Plan in case of Nuclear and Radiation Emergencies at Armenian NPP (off-site emergency plan of Armenian NPP) approved under the Government Decree № 2328 as of 22.12.2005 as amended in 2008, 2009;
- RA Government Protocol № 8 as of 03.03.2016 on approval of "National plan of civil protection in case of radiological and nuclear accidents in the territory of RA";
- RA Government Decree № 943-N as of 18.05.2016 on approval of "Establishing of regime of implementing rescue works in the areas of radioactive contamination";
- "Armenian NPP emergency response plan to nuclear and/or radiation emergencies (On-site plan of the Armenian NPP);
- Basic Requirements to Emergency Planning and Response at Nuclear and Radiation Emergencies;
- RA Government Decree № 1219-N as of 18.08.2006 on approval of radiation safety norms;
- RA Government Decree № 1489-N as of 18.08.2006 on approval of radiation safety rules.

The basic framework for preparedness and response to nuclear and radiation emergencies in the RA is established in the above mentioned legal acts, which assign the main roles to the state authorities and other organizations and regulate issues related to different aspects of emergency preparedness and response. The "Radiation safety norms" stipulate the generic optimized intervention levels for taking urgent protective actions for sheltering, evacuation, iodine prophylactic and permanent resettlement, as well as the dose criteria for emergency workers.

Besides the above mentioned, there are a number of legal acts dealing with separate issues concerned with the emergency preparedness (notification, organization and implementation of evacuation, transportation, emergency radiation monitoring, medical response, agricultural countermeasures and so on).

### Structure of the National Emergency Response System

The National Plan on Population Protection in case of a nuclear and radiological emergencies at Armenian NPP provides with the detailed assessment of organizational measures and allocation of the functions and responsibilities of the operator and the national and local authorities implementing response measures in case emergencies at the Armenian NPP (Government Decree № 2328-N as of 22 December 2005, amended in 2008 and 2010 respectively). This plan had been developed with account taken to requirements of the IAEA GS-R-2, GS-G-2.1 and EPR-METHOD-2003.

The plan revised based on GSR part 7, GSG-2 taken into account new radiological intervention criteria established in GSR Part 3. The revised version of plane enforced by Government Decree № 248-N in 1 March 2018.

According to the National Plan on Population Protection (the off-site plan):

- Armenian NPP is responsible for classification of emergency situation at NPP, prompt notification on emergency situation, bringing the reactor in safe condition and NPP personnel protection;
- Ministry of Emergency Situations of the Republic of Armenia (MES) is responsible for warning of national response organizations and population, coordination of population protection measures, organization of emergency radiological monitoring and performing rescue actions in emergency situations. From 2008 the Armenian Rescue Service (ARS) functions within the MES. The Rescue Service of Armenia functions as the national coordinator in organization and implementation of population protection measures. To cope with this task there was established the Crisis Management Centre of the MES equipped with new equipment and communication means. The MES is the competent authority and the contact point under the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency. The Ministry for Emergency Situation transmits radiation monitoring data in area where emergency took place and in adjacent to its territories to the ANRA ERC;
- ANRA is the national advisor in organization of response and also the National Warning Point under the Convention on Early Notification about Nuclear Accident. In case of threat to population ANRA notifies Ministry for Emergency Situations on emerged situation, provides with information on situation in the area where emergency took place;
- Hydrometeorological Service provides ANRA ERC and Ministry for Emergency Situations with the information on meteorological situation in the area where emergency took place and the meteorological prognosis;
- Ministry of Foreign Affairs of the RA is responsible for providing information received from ANRA ERC on emergency to the embassies, foreign representative offices and RA Embassies in other countries;
- Ministry of Health of the RA is responsible for provision of medical aid to the affected population, coordination of evacuation of injured persons from contaminated area and participation in organization of decontamination of evacuees;
- Ministry of Defense of the RA is responsible for conducting emergency radiological monitoring, deployment of forces and resources necessary for rescue operations and deployment of decontamination and special treatment units;
- Police of the RA is responsible for warning and notification of the population, protection of property and assets of the settlements in the contaminated area and maintaining public order in settlements, organizations, evacuation points, and transportation routes;

The responsibilities of the local authorities on the regional and local levels in the territory included in PAZ or UPZ are indicated in the off-site emergency plan of Armenian NPP. The local authorities perform the displacement, reception and the distribution of the displaced people, sheltering and provision of individual protection for the population.

The organizational chart of the population protection planning system will updated with regard to recent changes in the RA government structure.

To cope with its task ANRA operates the appropriately equipped Emergency Response Center (ERC) and has relevantly trained emergency personnel. The functions of ANRA ERC groups are:

- Emergency Commission – management of the ERC operations;
- NPP technological assessment group – assessment of nuclear reactor condition, prognosis on possible changes of the reactor condition, estimation of radioactive releases and discharges and conditions;

- Radiation Situation Assessment and Prognoses Group – assessment of situation at the facility or place where accident took place, prognosis on possible changes of situation, development of recommendations on protective measures;
- Information and Public Relations Group – receiving from and sending to information of the emergency commission, providing information to IAEA, communication with public and mass media.

There are relevant emergency procedures established to ensure functioning of ANRA ERC groups. Among the others there are procedures established that specify sequence of implementation of reactor condition and source term assessment, assessment of radiological situation of the Armenian NPP and adjacent territories, prognosis on situation change, development recommendations on radiation protection of the Armenian NPP personnel, emergency personnel, population and other.

To ensure 24 hours operation of ANRA ERC (in 3 shifts) starting from 2016 all staff members of ANRA and NRSC are included in the respective ERC groups according to ANRA Chairman order.

The emergency procedures are periodically revised during/after the regular table-top exercises within ANRA. The scheme of ANRA ERC and interaction with external organization is provided in Annex 7.

ANRA ERC personnel acts according to the requirements established in the set of the emergency procedures. In accordance with ANRA annual work plan trainings of ERC personnel are performed on a quarterly basis. All trainings are organized in accordance with the programs developed for each specific case. The evaluation of actions of each trainee is made after each training based on check-list. Once a year starting from 2016 NRSC as a developer of the package of procedures on activation and organization of ANRA ERC organizes training for ANRA and NRSC personnel involved in ERC activities. Assessment of the personnel actions is performed based on check-lists (as part of the procedure) during the exercises.

Twice a year emergency exercises are organized jointly with Armenian NPP with the purpose to increase the interaction level of ANRA and Armenian NPP personnel involved in the emergency response. National exercises are organized in accordance with the RA Government Decree once per three years.

MES of RA periodically conducts exercises and drills related to Armenian NPP which are aimed at testing capabilities and skills of the state and local authorities on various levels.

The emergency exercises were conducted with participation of ANRA, Armenian NPP and MES in 2016 (27 October and 19 December), 2017 (12 April and 05 December), 2018 (13 April and 19 October), 2019 (10 April and 19 July) respectively.

## Summary of activities related to the Armenian NPP emergency preparedness

The existing emergency response system at Armenian NPP is designed for prevention of emergency situations, prevention or limitation, mitigation of radioactive release impact, localization and timely mitigation of accident consequences.

The Armenian NPP emergency response is implemented by the emergency personnel in the frame of a specially established organizational structure of the emergency response system (ERS). ERS management structure is a part of the general management structure of Armenian NPP.

The manager of emergency activities, i.e. the Armenian NPP General Director, is in charge of the ERS.

Armenian NPP ERS includes the following functional units:

- Manager of emergency activities;
- Committee on Emergency Situations of Armenian NPP;

- Armenian NPP operating personnel;
- Headquarters of Civil Defense & Emergency Situations;
- Coordinator of public and media relations;
- ERS structural units;
- Personnel of the physical protection department;
- RA Police military unit;
- Specialized brigade for Armenian NPP fire protection.

Armenian NPP emergency response system is coordinated by the Committee on Emergency Situations (CES). The chairperson of the CES is the Armenian NPP Chief Engineer. CES activity is implemented under the direction of the manager of emergency activities, i.e. the Armenian NPP General Director.

The headquarter, the Armenian NPP Civil Defense and Emergency Situations Service, is the executive authority of the CES.

The Armenian NPP Notification Scheme is provided in the Annex 8.

Besides the national organizations 8 Armenian NPP cooperates with WANO MC Regional Crisis Center for WWER type reactors on the basis of "ROSENERGOATOM" OJSC Crisis Center. Interaction with the RCC of WANO-MC is regulated by the requirements of the following documents:

- Regulations on the Regional Crisis Center of the NPP with the WWER reactor of the Moscow Center of WANO, registration number R16-2012;
- Regulations for information exchange between the participants of the Regional Crisis Center of NPPs with the WWER reactor of the Moscow Center of WANO, registration number R15-2013;
- Regulations for the operation of the Regional Crisis Center for Nuclear Power Plants with WWER reactor of the Moscow Center of WANO, registration number R21-2016.

To ensure proper response, Armenian NPP ERS is provided with the required material and technical means and support, and also with the emergency equipment and special premises.

The special premises are assigned which could be used at various stages of emergency response, such as:

- Emergency control board for the MCR operating personnel;
- Crisis center;
- Reserve crisis center;
- Shelters;
- ERS property warehouse.

There are special systems and channels of emergency and regular communication and notification developed and implemented at Armenian NPP.

## Personnel training, exercises and drills

Armenian NPP organizes systematic training under the relevant programs and in accordance with the approved schedules.

The topics of the emergency preparedness and response are annually included into the topical plans of the initial briefings for the personnel of structural units.

The issues of the emergency preparedness and response are included in the examination questionnaires of Armenian NPP personnel.

The skills on appropriate accident response are maintained through periodical exercises and drills which follow specially prepared scenario and involve all officials who are responsible for critical emergency response objectives.

The exercises and drills are systematically assessed, and based on the results a plan of correcting measures is developed. Their timely and proper implementation is followed-up.

## Notification

The Instruction on "Organization of notification and communication in case of emergency situations at the Armenian NPP" (hereafter referred to as the instruction) establishes the procedure of organizing notification and communication of information from the moment when "Preparedness", "Local accident" and "General accident" situations are declared at Armenian NPP.

The notification is organized according to the Notification Scheme provided in Annex 8.

The permanent duty in the Crisis Management Centre (CMC) of MES ensures prompt response to emergency situations.

## On-Site Emergency Response Plan

The on-site plan of Armenian NPP is the principal document that establishes organization and procedure of responding to nuclear and radiological emergencies at Armenian NPP, settles down relations of entities involved in the emergency activities.

"Plan on Response to Nuclear and Radiological Emergencies at Armenian NPP" (on-site plan) is reviewed with respect to the requirements established in the IAEA document "Methodology of Developing Activities in Response to Nuclear and Radiological Emergency Situations" (EPR – methodology - 2003). The improvement of the Armenian NPP on-site plan is scheduled to be implemented in 2020.

At ANRA's request Armenian NPP developed criteria (EAL) and selected observable thresholder for emergency classification that follows the requirements of the IAEA GS-R-2.

The emergency classification consists of 3 classes of emergency which are: General emergency, Site area emergency and Alert. The emergency classification criteria was justified through analytical calculations. There were developed criteria for emergency classification applicable for different conditions at Armenian NPP: power operation, hot shutdown, cooldown, cold state and refueling.

## Regulatory review and control activities

ANRA conducted inspections to verify implementation of the Armenian NPP on-site plan as it is provided for in the license terms and conditions. The following issues have been inspected:

- Armenian NPP on-site plan;
- Armenian NPP personnel evacuation plan;
- organization of medical protection of the Armenian NPP personnel during emergency situations;
- Organization and implementation of emergency and rescue works during emergency situations;
- Organization of communication and notification during emergency situations;
- Instruction on organization of evacuation measures during emergency situations;
- Instruction for technical support group;

- Radiation monitoring program during nuclear and radiation emergencies;
- Manual on classification of emergency situations at the Armenian NPP;
- Armenian NPP personnel and management preparedness programs;
- Training methodology and its implementation;
- Shelters, located at the Armenian NPP site and their habitability;
- Organization of iodine prophylactic and distribution.

The requirements specified in the ANRA's act-enforcement issued as a result of inspection are in process of implementation.

At ANRA's request, the number of annual exercises at Armenian NPP has been increased.

ANRA resident inspector takes part in the exercises and prepares act or act-enforcement. One of the duties of the resident inspector is to verify the availability and condition of shelters and other emergency preparedness facilities.

## 11.2 INFORMATION OF THE PUBLIC AND NEIGHBORING STATES

The responsibilities for notification about nuclear and radiological emergencies at Armenian NPP are established in the Basic Requirements to Planning and Response to Nuclear and Radiological Emergencies and in the emergency response plans.

According to the above mentioned regulation, the responsibilities for notification rest with:

- Armenian NPP – notification of the population residing in the preventive actions zone (PAZ);
- MES – notification of the population residing in the urgent protective actions zone (UPZ), and if necessary also the population of other settlement;
- ANRA – international notification about nuclear and radiation emergencies at Armenian NPP, and receiving information about emergencies occurred in nuclear installations of other countries through the IAEA ERC.

According to the requirements of the RA administrative and regulatory documentation and the National Plan on Population Protection, Armenian NPP is responsible for informing population in PAZ (PAZ – 5km area around the Armenian NPP). The notification of the population outside PAZ and the mass media is made by the RA MES. If necessary, the coordinator on relations with mass media and public, jointly with ESC representatives prepare relevant and timely information for mass media about an accident, in order to provide correct and complete information on required protective measures and further progress.

Such information is distributed in the form of information cards, news releases, messages on official web pages of the response organizations, local radio and television, and also in the form of briefings and press conferences.

The Republic of Armenia is a party to a number of international treaties and conventions on emergency response and planning related issues (Annex 1).

The Republic of Armenia participates in the IAEA Convex exercises organized in accordance with the IAEA annual schedule.

The Armenian organizations and authorities cooperate with the IAEA (in frame of technical cooperation projects), USA, and EC on different issues related to the emergency response and planning.

In case of need the coordinator on relations with mass media and public, jointly with the ESC representatives prepares information for mass media about an accident, in order to provide correct and complete information on required protective measures and progress of the situation. Such

information is distributed in a form of information cards, news releases, information messages on official sites of response organizations, local radio and television, and also in the form of briefings and press conferences.

# 12 NPP SITING

***Article 17 Siting***

***Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:***

> ***(i) for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;***
>
> ***(ii) for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;***
>
> ***(iii) for re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;***
>
> ***(iv) for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.***

## 12.1 EVALUATION OF SITE RELATED FACTORS

The site selection of the Armenian NPP was made in 1968 in accordance with the normative documents existing at that period. Thus, practically the siting factors which can impact the NPP safety were taken into account:

- NPP site is located on solid, crystal and basalt area;
- Geological conditions of the site are acceptable, steady;
- Ground waters deposited on the depth 85-90m;
- Volcanic hazard of the site is extremely small;
- Other natural events (flooding, tornado, landslides and so on) on the territory of the site are not observed.

Then, additional activities related to the site factor have been performed in accordance with:

- Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes;
- Law of the RA on Licensing;
- RA Government Decree № 609-N as of May 12, 2005 on approval of the licensing procedure and licence form for site selection of nuclear installations;
- RA Government Decree № 708-N as of July 04, 2013 on approval of the Site Safety Requirements to New NPP Unit(s);
- IAEA Safety Standards.

The objective of the RA Government Decree № 708-N is to establish the requirements to NPP Unit(s) site to characterize fully the site specific conditions pertinent to the safety of the installation.

After the Spitak earthquake in December 1988 and during the shutdown period of the plant the implementation of the seismic upgrading programme was continued.

Three important aspects were fulfilled:

- Verification of the geological stability of the site, (absence of any capable fault that can produce permanent ground displacement phenomena);
- Determination of the severity of seismic ground motion at the site, (seismic design related parameters, such as peak ground acceleration, ground response spectra, duration, time history accelerations, etc.);
- Establishment and development a complete programme for the re-evaluation of the seismic capacity of buildings, systems and components important to safety in accordance with new data, methods and criteria recognized in the international practice.

The seismic safety related issues of Armenian NPP unit №2 are specified in the special program on Armenian NPP Unit №2 seismic safety re-evaluation and improvement, where complex measures of analytical and engineering and technical nature and also the deadlines for their implementations are specified. In the first place, the systems, structures and components for the safe shutdown of the plant should be strengthened.

ANRA has approved Armenian NPP Unit №2 seismic safety re-evaluation and improvement program that envisages implementation of comprehensive measures of analytical, engineering-technical nature and implementation of modifications with the purpose to improve the seismic safety level of Armenian NPP unit №2. ANRA regulates also seismic safety related issues of the dry spent fuel storage facility.

The assessment of external events impact on Armenian NPP safety was performed in frame of the PSA. Selection of external events important to the Armenian NPP site was made on the first stage of assessment. As a result, the following external events have been selected:

- Snow load;
- Wind load;
- Dust storm;
- Flooding due to accumulation of rain water;
- Explosion of pressure tanks;
- Extremely low temperature of air;
- Extremely high temperature of air;
- Aircraft crash.

Detailed analysis was performed for each of the selected events. The analysis demonstrated that the majority of selected initiating events with $10^{-6}$ [1/year] frequency do not result in damage of the systems, structures and components important to safety.

ANRA with NRSC support started development of regulations specifying processes of construction and site selection of a new NPP unit in Armenia, in particular:

- Guide on expertise of documents on new NPP seismic hazard assessment. The guide was revised by the experts from the US NRC and BNL. Comments are made to improve the format and contents of the guide.

In 2015 ANRA requested Armenian NPP to increase the level of maximum design basis accident with the equivalent diameter 200mm coolant leak in any point of the MCP. The Armenian NPP plans to implement the ANRA's requirement in the framework of activities on preparation of the Unit №2 for the extended operation.

## 12.2 IMPACT OF THE INSTALLATION ON INDIVIDUALS, SOCIETY AND ENVIRONMENT

Radiation Safety Norms and Rules were developed by ANRA and approved by the RA Government (see Annex 2) in 2006. Radiation Safety Norms and Rules define the radiation protection principles, establish the dose limits for categories of personnel under normal and accident conditions, and establish the requirements for exposure of members of the public to man-made sources under normal conditions and due to natural radiation sources. Radiation Safety Norms and Rules were developed in conformity with the international practice and the IAEA recommendations.

The environmental radiation impact of Armenian NPP is controlled by the NPP laboratory of external irradiation control. Within the Armenian NPP supervised area the control is established over the radioisotopes contents in the air, fallouts, underground waters, soil, greens, and also in several types of foods (meat, fish, milk, vegetables, fruits and so on). The radioisotopes contents in the underground waters nourishing the Aknalich Lake, Sevjur river and other nearest water objects is controlled by sampling from bore holes.

The maximum design basis accident was originally the primary leak with 32 mm equivalent diameter. ANRA required increasing of the maximum design basis accident and making relevant modifications aimed to improve the NPP safety level. Armenian NPP has started to implement ANRA's requirement. Activities to extend the maximum design basis accident up to 200 mm break are ongoing and will be fully implemented in 2020.

Armenian NPP in cooperation with the US DOE performs analysis of radiological consequences for selected initiating events. The analysis of radiological consequences were performed for design and beyond design accidents. The analysis results demonstrated that the population dose loads do not exceed the radiation safety norms adopted in the RA. In framework of spray system modernization, new radiological consequences analysis were performed for DBA and BDBA using new radiological consequence analysis methodology approved by RA. The analysis results demonstrated that the population dose loads do not exceed the radiation safety norms adopted in the RA for DBAs.

The monitoring of the Armenian NPP impact on environment and population in the Armenian NPP supervised area is performed by the Armenian NPP personnel, and the associated reports are submitted to ANRA on monthly and annual basis. ANRA evaluates the reports and prepares monthly reports and annual reports to the RA Government. The analysis of environmental monitoring results and the evaluation of population exposure dose origination through food chain show that the exposure dose incurred by the population residing around Armenian NPP was significantly lower than the dose limit mentioned in the section 10 of this report.

## 12.3 RE-EVALUATION OF SITE RELATED FACTORS

The measures on re-evaluation of the site related factors are aimed at ensuring continuous acceptability of the nuclear installation safety.

In 2012-2013 stress test was performed at Armenian NPP.

PGA=0,35g for RLE was kept as the design basis earthquake, and PGA=0,47g was established for the beyond design basis earthquake (BDBE) which corresponded to $10^{-5}$ annual probability on the median curve of seismic hazard.

According to the stress tests philosophy the list of SSC in the SSEL was extended with inclusion of the dry spent fuel storage facility, auxiliary building, ventilation stack, room of inlet water tank №2, the Armenian NPP Unit №1 spent fuel storage pool; and additional calculations of the boundary seismic stability of the mentioned buildings were made.

Based on the results of the implemented analyses, the pipelines and some components of the Unit №1 storage pool were reinforced; hydrants were installed on the demineralized water storage tanks. The

opening of 0,5m height and 50m length was arranged on the lower level of the wall of outlet channel water scoop to prevent flooding of the RDGS structures.

It was confirmed that Armenian NPP Unit №2 corresponds to the design basis earthquake (PGA=0,35g), and the minimum earthquake level (PGA=0,47g) was specified which the plant can withstand without the core damage and severe accidents.

Based on the stress tests results and in order to identify the components and systems, which require further modifications, the Armenian NPP was recommended to implement the seismic probabilistic safety analysis.

Also, it was recommended to implement the seismic margin assessment for the fire extinguishing system and install additional fuel tank for filling the DG reserve tanks. These measures were included in the schedule of measures to be implemented in 2016-2017 to fulfill the Stress Tests Recommendations.

## Results of recent reassessment activities

Based on the 3rd iteration of PSA for internal initiating events the seismic PSA was developed by the Risk Engineering Company (Bulgaria) in 2014. The total core damage frequency due to seismic effect is 1.39E-05 1/y. The results of CDF for all intervals are demonstrated in the Table 1. The CDF distribution by specific intervals is demonstrated in Figure 1. The conditional probability of the plant damage for separate intervals is demonstrated in Figure 2.

**Table 1**

| Interval | LVL0 | LVL1 | LVL2 | LVL3 | LVL4 | LVL5 | LVL6 | LVL7 |
|---|---|---|---|---|---|---|---|---|
| PGA, g | 0.05-0.0.1 | 0.1-0.2 | 0.2-0.4 | 0.4-0.6 | 0.6-0.8 | 0.8-1 | 1-1.5 | 1.5 ≤ |
| Seismic effect freq., 1/y | 1.51E-02 | 2.42E-03 | 3.68E-04 | 3.48E-05 | 6.78E-06 | 1.81E-06 | 8.11E-07 | 1.00E-07 |
| CCDP | 5.06E-05 | 8.23E-05 | 4.24E-03 | 1.25E-01 | 6.71E-01 | 8.87E-01 | 9.77E-01 | 1.00E+00 |
| CDF, 1/y | 7.63E-07 | 1.99E-07 | 1.56E-06 | 4.36E-06 | 4.55E-06 | 1.60E-06 | 7.92E-07 | 1.00E-07 |

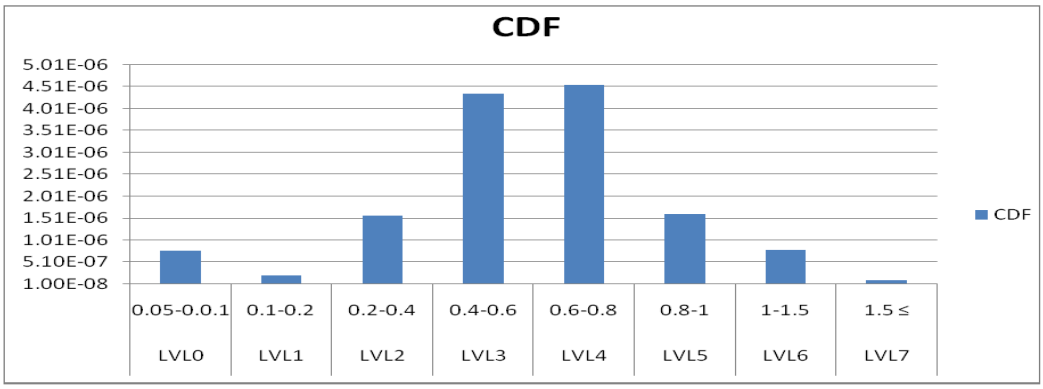



**Figure 1. CDF by intervals**

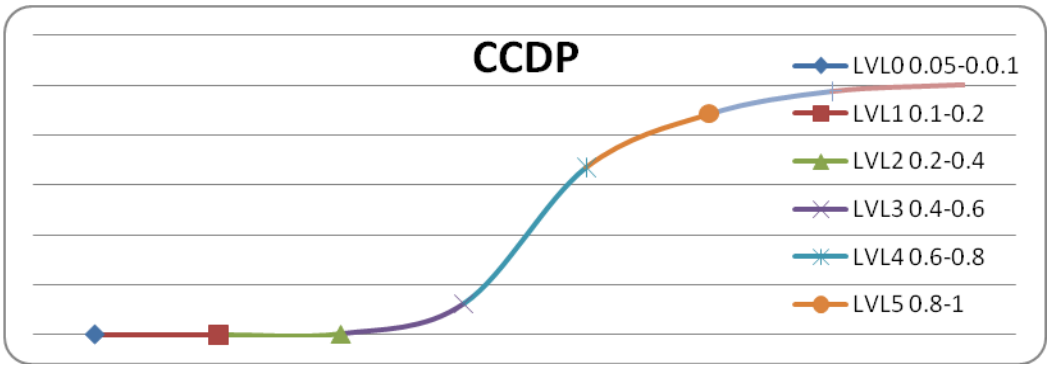



**Figure 2. CCDP by intervals**

In 2013 the "Armatom" Institute, based on the 3rd iteration of PSA for internal initiating events, developed the PSA for external initiating events. Total CDF due to external events is 5.47E-06 1/y (2.0E-05 1/y in the 2004 model). According to the results the dusty storm is the largest contributor in the Armenian NPP core damage risk (95%).

The core frequency damage factor is contributed by the following external events:

- Strong wind 3.89E-10;
- Dust storm 5.24E-06;
- Low air temperature 2.11E-07;
- Snow load 1.31E-08;
- Airplane crash 7.83·10-9/y.

In 2013-2015 the seismic PSA was reviewed based on the received in 2011 new seismic hazard curves (with $10^{-1}$ - $10^{-7}$ probability) and the corresponding response spectra were represented for 5%; 15%; 50%; 85% and 95% confidence. In frame of the seismic PSA a human factor was considered, and secondary consequences of earthquake, fire and flooding, were reviewed.

The fragility curves were received for 3300 components of SSC (considerably exceeding the number of SSC in the previous PSA as of 2006).

As a result the total CDF value conditioned by the seismic effect reached 1.39E-051/y.

This result was received based on the analysis of 8 seismic intervals (from 0,1g to 1,5g) and 11 groups of the plant damage conditions.

It should be noted that there is no interval for which the CDF value is higher than 1.0E-51/y.

The IAEA IPSART mission reviewed the general PSA materials and, in parallel, the seismic PSA. The mission made a number of specific recommendations which were completely implemented and reflected in the final PSA as of 2015.

## 12.4 CONSULTATION WITH OTHER CONTRACTING PARTIES LIKELY TO BE AFFECTED BY THE INSTALLATION

The list of international treaties ratified by the Republic of Armenia is provided in Annex 1 of this report.

On 2015 December 24, the Republic of Armenia and the Islamic Republic of Iran signed the Memorandum of Understanding. In the frame of that Memorandum are established the working group for coordination the cooperation on nuclear energy between Parties, as well as for exchange of information.

The Republic of Armenia has no bilateral arrangements with the neighboring states**.**

# 13 DESIGN AND CONSTRUCTION

***Article 18. Design and Construction***

***Each Contracting Party shall take the appropriate steps to ensure that:***

> ***(i) the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defense in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;***
>
> ***(ii) the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;***
>
> ***(iii) the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.***

## 13.1 IMPLEMENTATION OF DEFENSE IN DEPTH

In Armenia the main legal acts settling the relations concerned with response to nuclear and radiological emergencies are:

- Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes;
- General Regulations On Ensuring Safety of Nuclear Power Plants, OPB -88/97;
- RA Government Decree № 1411-N as of November 08, 2012 on approval of the Design Safety Requirements to New NPP Unit(s).
- The content of the RA Government Decree № 1411-N includes:
- Safety goals;
- NPP main safety requirements;
- Proved engineering and technical practice;
- Safety assessments;
- Classification of safety equipment;
- Requirements to SSC safety.

Armenian NPP design was developed with respect to the defense-in-depth principle. In accordance with this principle the Armenian NPP design includes five levels of defense and four main barriers to prevent release of radioactive materials into the atmosphere.

All five levels of the defense in depth are implemented at Armenian NPP. The safety deficiencies related to the implementation of defense levels are documented and the upgrading measures are planned in the Comprehensive Safety Upgrading Programme.

The many years' experience of successful operation of WWER-440 reactors demonstrated the validity and reliability of the accepted design solutions. The positive features of WWER-440 reactor facility are: comparatively low power rating of the core, availability of specific volume of the primary coolant and cooling water reserve in the SGs of the secondary side and features of the primary side contributing to the coolant natural circulation that enables the passive core cooling in the natural circulation modes during accidents for a long time and reduces dependency on earlier operator actions.

At designing of Armenian NPP that was supposed to be operated in the seismic area it was accepted that systems, structures and components ensuring the safety of personnel and population and also protection of the environment against contamination above the allowable limits should remain operable to certain degree at any seismic impacts possible at the NPP site.

In 1993 the IAEA ARM/9/002 project on methodological and technical support in seismic reassessment of Armenian NPP was established in the framework of the IAEA technical cooperation program. The IAEA developed a Technical Guidance to be applied in implementation of the seismic reassessment program. In 1999 it was approved by ANRA as a basis for implementation of the program which is currently successfully completed.

The initial design-basis earthquake intensity for Armenian NPP corresponding to 7 points (PGA≅0.1g) was revised more than once and currently it forms 0.35g for horizontal direction.

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To prevent escalation of design bases accident into beyond design basis accident and also to reduce radiological consequences at beyond design accidents the following upgrades have been implemented at the Armenian NPP:

- Upgrade of the primary circuit protection system against pressure rise. In particular, installation of the PRZ impulse safety valves certified to be operated in water media;
- Upgrade of the secondary circuit protection system against pressure rise. In particular, installation of the SG impulse safety valves certified to be operated in water media;
- Upgrade of the steamline system. In particular, installation of fast acting valves;
- Upgrade of the automatic DG start-up system. This upgrade enables actuation of 2 pumps in each safety channel of the emergency core cooling system at the total power loss at the Armenian NPP;
- Implementation of a completely independent essential service water system;
- Upgrade of the emergency core cooling system actuation logic;
- The confinement tightness is regularly increased;
- The system for additional make-up of SG with installation of diesel pump was implemented;
- Partial separation of the electric power supply and I&C channels;
- Implementation of the system for the reactor pressure vessel protection against cold overpressurisation;
- Implementation of the Leak Before Break concept and installation of the leak detection systems;
- Assessment of the high energy piping and implementation of associated measures;
- Installation of filters against clogging of the confinement sump;
- MCR habitability improvement;
- Installation of the post accident monitoring system and the backup control panel;
- Installation of restraints against pipe whip on the main steamlines;
- Installation of the full-scale simulator;
- Separation of the reactor protection system into two independent channels;
- Establishment of the emergency control room.

Armenian NPP has started implementation of the ANRA's requirement made in 2015 to increase the maximum design basis accident up to the pressurizer surge line break (2x209mm) and break on cold leg with equivalent diameter of 100 mm. It includes modernization of the spray system (separate systems into two independent channels) and the ECCS (installation of two independent channels of Low-Pressure Injection System).

The modernization of the spray system is in process and will be completed during the outage 2019. The modernization is aimed to separate systems into two independent channels and increase of water

flow rate supplied by the spray system into the confinement. The safety justification of spray system modernization was approved by ANRA.

The ECCS modernization is planned to be implemented in 2020.

The following upgrades are planned to be implemented:

- Replacement of the industrial seismic protection system (ISPS);
- Improvement of uninterruptible power supply system (replacement of accumulator batteries, replacement of reversible diesel generators, replacement of thyristor transducers);
- Improvement of electric equipment of reactor protection and control system;
- Improvement of generator system (with replacement of generators, dismantling of auxiliary generator and implementation of thyristor excitation system);
- Implementation of passive autocatalytic recombiners to prevent accumulation of explosive hydrogen concentration in the confinement;
- Implementation reactor under cover gas removal system;
- Recovery of the software life for information and computation system (ICS), in-core monitoring technological system (ICMTS),

In addition, several safety upgrades have been recommended to Armenian NPP based on the comprehensive safety assessment project implemented by the international consortium in co-operation with the IAEA. Based on the results of the performed comprehensive safety analysis the list of safety upgrades for the Armenian NPP Unit №2 had been revised.

Based on the result of the Armenian NPP self-assessment report and the conclusions made by the EC peer-review team following the review of the national report on the Armenian NPP stress test ANRA developed national action plan in 2017. The safety upgrades listed in the action plan are in process of implementation.

ANPP developed symptom-oriented EOP and SAMG which include power and shutdown states. The developed EOP and SAMG submitted to ANRA and currently undergo the regulatory review.

The ANRA implements regulatory control through the regular inspections in accordance with its annual schedule.

## 13.2 INCORPORATION OF PROVEN TECHNOLOGIES

According to the paragraph 1.2.5 of the General Safety Regulations (OPB -88/97) “Technical and administrative decisions made to ensure NPP safety shall be well proven by the previous experience or tests, investigations, operating experience of prototypes and shall meet requirements of regulatory documents. Such approach shall be applied not only in development of equipment and design of the NPP but also in manufacture of equipment, construction and operation of the NPP, its backfitting and reconditioning of its systems (elements)”.

According to the paragraph 3.1 of the RA Government Decree № 1411-N “The first level of defense requires the prevention of transients, accidents and other deviations from normal operation. The plant must be designed, constructed, maintained and operated in accordance with high quality levels and proven engineering practices, selection and application of appropriate design codes and materials”.

The recommendations of IAEA and WENRA were taken into account during development of the document and relevant documents were studied.

The description of review and control activities of ANRA is provided in detail in the section 9.1 of this report.

In implementation of modifications it is a matter of principle for Armenian NPP to apply only the systems and equipment with proven operation at any of the world NPPs.

Implementation of modification projects upgrades the reliability of equipment operation.

Obsolete analogue information and control systems are replaced by new digital components, in particular, in the framework of Armenian NPP Unit №2 long-term operation programs the following is planned:

- Replacement in 2019 of complete electric equipment of the Control and Protection System with new digital equipment manufactured by SKODA, which passed test operation and showed successful results at Hungarian, Czech, and Slovakian NPPs;
- Planned replacement in 2019-2020 of MCR complete I&C in total 230 pcs. with digital one as a set with sensors. The types of instrumentation for replacement are successfully operated at Russian and Ukranian NPPs;
- Planned modification in 2019-2020 of automatic control system along with replacement of all analogue systems with digital ones which passed test at Russian NPPs.

### 13.3 DESIGN FOR RELIABLE, STABLE AND MANAGEABLE OPERATION

Armenian NPP is operated in accordance with the Technical Specification. The reliability of operation is provided through regular inspections, maintenance, testing and repair of the NPP technological systems having impact on safety. The information on verification of performance of safety important systems is provided to ANRA.

The impact of human factor on safe operation is described in detail in the section 7 of this report. The quantitative assessment of human factor impact on safety was made in frame of PSA.

ANRA conducts regular inspections in accordance with the schedule to ensure regulator control over implementation of the safe operation requirements.

The description of the regulatory review and control activities is provided in detail in the section 9.1 of this report.

## 14 OPERATION

***Article 19 Operation***

***Each Contracting Party shall take the appropriate steps to ensure that:***

***(i) the initial authorization to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;***

***(ii) operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;***

***(iii) operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;***

***(iv) procedures are established for responding to anticipated operational occurrences and to accidents;***

***(v) necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;***

***(vi) incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;***

***(vii) programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used***

***to share important experience with international bodies and with other operating organizations and regulatory bodies;***

***(viii) the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.***

## 14.1 INITIAL AUTHORIZATION

The analysis of the design safety was performed in 1995 before Armenian NPP Unit №2 restart in accordance with the NPP restart concept.

The following analyses with application of the deterministic approach have been performed:

- "Complex analysis of NPP design safety level based on deterministic and probabilistic approaches" Atomenergoproekt, 1994;
- "Report on thermal hydraulic calculations to justify design operation conditions of Armenian NPP unit №2". Gidropress, 1995;
- "Final safety analysis report of Armenian NPP" Framatom, 1992;
- "Report of Bechtel Corporation specialists";
- "Analysis of working conditions, materials and radiation resource of Armenian NPP Unit №2 reactor vessel". Gidropress, 1995;
- "Re-evaluation of Armenian NPP seismic conditions", 1995.

Based on the safety analysis the ANRA issued annual permits for operation. Then, the ANRA developed the requirements to the SAR, based on which the operating organization prepared the documents for obtaining the operation license in accordance with the RA Government Decree № 400-N as of 24.03.2005 on approval of the licensing procedure and licence form for operation of nuclear installations.

The following documents have been developed and enforced by the ANRA, in support to LTO project:

- Requirements for the form and content of the Comprehensive Survey Report (ANRA order № 9-N as of 2016);
- The methodology for analyzing the deviations in the NPP unit design and in the existing condition from the requirements of the legal acts in the field of atomic energy use (ANRA order № 98-A as of 2016);
- Requirements for Aging Management of systems, structures and components important to safety of NPP (ANRA order № 125-A as of 2017);
- Requirements to Equipment Qualification (ANRA order № 126-A as of 2017).
- Requirements to Maintenance Effectiveness Monitoring Proces (ANRA order №127-A as of 2017).

## 14.2 OPERATIONAL LIMITS AND CONDITIONS

The operational limits and conditions of Armenian NPP are brought in compliance with the technical standards set in the Armenian NPP design. The set of safe and normal operation limits and conditions is specified in the Technical Specification for operation of Armenian NPP unit №2 with WWER-440 (V-270) type reactor. ANRA verifies the safety management, maintenance and repair and control through inspections. ANRA identified progress on the side of operating organization in relation to

establishment of the programs on testing of safety systems and the success criteria. Armenian NPP initiated development of new administrative procedures. The recommendations on improvement of the procedures for maintenance and repair have been made.

The radiation protection and safety limits and conditions are specified in the Technical Specification on Radiation Monitoring and provided in the section 10 and in Annex 6 of this report.

The working places of personnel involved in safety activities are provided with documents required for safe implementation of technological process in compliance with the established limits and conditions.

Training and examination of personnel involved in safety related activities are performed in compliance with the requirements of existing standards and regulations.

The operating limits and conditions are reviewed, as appropriate, in the established order in compliance with the requirements of regulatory documents, and also during assembly, modernization, and reconstruction activities.

## 14.3 PROCEDURES FOR OPERATION, MAINTENANCE, INSPECTION AND TESTING

The operation, maintenance, inspection and testing procedures established at Armenian NPP with respect to the requirements of the rules and standards, are revised in accordance with the established frequency as well as implementation of modifications, upgrades and operational experience feedback.

Through inspections and tests, maintenance and repair, the safety systems are maintained in operable condition to fulfill functions attributed by the design. In compliance with the administrative management procedures the operating personnel is provided with all the required documentation, procedures at their work places and receives training according to the training program.

A complete set of operational documents for Armenian NPP systems and equipment is developed at the for improvement of Armenian NPP operational safety. The complete set of operational and technical documentation includes normal operating procedures, technical descriptions, emergency response procedures and programs for checking operability and testing. Armenian NPP has established a procedure for making changes and revising the administrative and operating procedures. Before implementation the complete set of operational and technical documentation is verified and validated by the relevant Armenian NPP personnel having relevant work experience and qualification.

The responsibility has been defined for completeness and safety of the complete set of operating procedures available at the work places of the operating personnel according to the approved distribution list. The copies of the complete set of operating procedures available at work places of Armenian NPP personnel are intended for information, training and drills. The administrative and operating procedures are revised according to the procedure established at Armenian NPP.

The operation, maintenance, inspection and testing procedures established at Armenian NPP with respect to the requirements of the rules and standards, are revised in accordance with the established frequency as well as implementation of modifications, upgrades and operational experience feedback.

Through inspections and tests, maintenance and repair, the safety systems are maintained in operable condition to fulfill functions attributed by the design. In compliance with the administrative management procedures the operating personnel is provided with all the required documentation, procedures at their work places and receives training according to the training program.

Development of a full set of EOPs (at full power and for shutdown modes) based on the Westinghouse Owners Group Emergency Response Guidelines (WOG ERG) is in process. The project is supported by the US Department of Energy with Pacific North National Laboratories and Argonne National Laboratories.

The maintenance and testing procedures developed by Armenian NPP are agreed with ANRA. The results of testing of the safety systems are submitted to the ANRA in a due frequency as established in the requirements.

## 14.4 PROCEDURES FOR RESPONDING TO OPERATIONAL OCCURRENCES AND ACCIDENTS

The safety systems through inspections and tests, maintenance and repair are maintained in operable condition which is a guarantee of implementation of the safety functions. The operating personnel, in compliance with the procedures of administrative management are provided with all the necessary documents, procedures in their work places and are trained according to training programme.

The procedures for the Armenian NPP personnel response, protection, organization and implementation of the emergency radiation monitoring in case of operational events and accidents are defined in the Armenian NPP on-site plan which are periodically tested during exercises and drills organized at the Armenian NPP on a regular basis.

### Development of event - oriented and/or symptom - oriented emergency operating procedures

New symptom-oriented emergency operating procedures (SOEOPs) are developed for the reactor power operation condition instead of old EOPs Within the framework of US DOE and Argonne Laboratory assistance project for Armenian NPP.

SOEOPs for the Armenian NPP consist of four sets of procedures:

- For optimal recovery;
- For recovery of the critical safety functions (CSF);
- For recovery of CSF in the reactor shutdown condition;
- For the spent fuel storage pools of Unit №1 and Unit №2.
- EOPs for shutdown mode is in process revising based on ANRA's comments and suggestions.

EOP for the cooling ponds of Armenian NPP Unit №1 and Unit №2 are revised and in the process of verification.

Development of a full set of EOPs (at full power) based on the Westinghouse Owners Group Emergency Response Guidelines (WOG ERG) is completed and is in process of independent review. The project is supported by the US Department of Energy with Pacific North National Laboratories and Argonne National Laboratories.

Certain procedures at Armenian NPP will be revised with regard to results of the stress test of the Armenian NPP.

### Development of severe accident management guidelines

Within the framework of US DOE and Argonne Laboratory assistance project for Armenian NPP SAMG, the SAMGs is developed by the "Armatom" Institute.

The approach for establishing the SAMG is based on the Westinghouse generic guidelines.

The SAMGs for power mode, shutdown mode and for spent fuel pool is in process of independent review.

## 14.5 ENGINEERING AND TECHNICAL SUPPORT

At present functions of the operating organization are assigned to Armenian NPP. The following departments have been established within the structure of the plant to provide with the internal technical support in the safety improvement:

- Nuclear safety and reliability department;
- Engineering and technical support department;
- Workshop for thermal automatics and measurement;
- Technical department of planning and operation;
- Technical inspection
- Buildings and structures maintenance department;
- Operating experience department;
- Ageing management group;
- Life time extension department.

Besides there are also external technical support organizations in Armenia, in particular:

- "Armatom" CJS;
- "Atomservice" CJS;
- "Institute of Energy" CJS.

The technical support is received also from foreign organizations in frame of international assistance programs (IAEA, EC, USA).

The responsibility for coordination of activities with the external support organizations in Armenia rests with the operating organization.

The engineering and technical support is provided mainly for the safety upgrades of Armenian NPP that cover all safety aspects.

## 14.6 REPORTING OF INCIDENTS SIGNIFICANT TO SAFETY

In accordance with the Article 20 of the Law of the RA on Safe Utilization of Atomic Energy for Peaceful Purposes the operating organization should investigate accidents and incidents occurred during operation of nuclear installations. In accordance with the General Safety Regulations, the operating organization should provide the ANRA with information on operational events in the established order. The criteria for selection of events to be reported to the regulatory authority, are described in the procedure on investigation of NPP operational events approved under the RA Government Decree № 418-N as of 05.04.2012. The procedure covers issues related to notification, account, investigation and reports on operational events occurred at the NPP and establishes:

- Categories of operational events;
- Procedure of accounting and notification of events;
- Procedure on investigation of events.

Events, detected during implementation of operational and maintenance activities, walkdowns, inspections, audits etc. at Armenian NPP should be reported. Any unfavorable, unforeseen action that resulted in deviation from the established requirements and standards should be also reported to ANRA. Events to be reported to ANRA are classified by the INES scale in accordance with "International Nuclear and Radiological Event Scale (INES)", 2008 Edition. At ANRA' request the assigned event level can be changed.

In accordance with the established procedure a preliminary event report is prepared within 24 hours after an operational event is detected and sent to ANRA. A 15-days period is specified to investigate causes of the event and to submit the event investigation report to ANRA.

The reports on investigation of operational events are analyzed by ANRA. If a root cause is not detected or the corrective measures do not fully cover and prevent reoccurrence of event ANRA may require additional investigation. ANRA can conduct inspection of corrective measures implemented at Armenian NPP.

ANRA has established a database of operational events. The database contains the following information: date of event, summary description of event, number of report on investigation, description of direct and root cause, corrective measures and deadlines for implementation, as well as the electronic version of complete report on investigation.

The information to the International Reporting System (IRS) is regularly provided. Data from the IRS database are analyzed and provided to the concerned authorities for use.

Reports on the events occurred at Armenian NPP is periodically presented at the Nuclear Energy Safety Council under the RA Prime Minister (former the Nuclear Energy Safety Council under the RA President) and to the WANO.

18 operating events have occurred in the reporting period, all events were rated at the INES Level "0" (deviation). The events occurred didn't result in violation of the safe operation limits and conditions. Corrective measures for all the violations were developed and implemented.

Based on the terms and conditions of the operation licence twice a year ANPP reports to ANRA the low level events and near-misses and their evaluation results and corrective measures.

## 14.7 OPERATIONAL EXPERIENCE FEEDBACK

A formalized program of operational experience (OE) was developed based on the IAEA PROSPER mission recommendations.

The Armenian NPP operational experience department (OED) is responsible for the OE program.

The management policy and expectations have been established for reporting on events (including low-level events with near-misses), threats, errors and organizational deficiencies.

A full set of 20 documents, formalizing the OE complete process, has been developed and implemented.

Training materials on new processes and methods have been elaborated, and the training of both OED personnel (on event review methodologies – ASSET, HPES), and of the rest of the NPP personnel have been performed.

The IAEA safety standards, WANO documentation, good practice of the other NPPs have been used during implementation of the OE program at Armenian NPP.

Review of events occurred at the plant is performed in accordance with the guideline on determination of event direct and root causes.

The event investigation is performed with application of ASSET (Assessment of Safety Significant Events) and HPES (Human Performance Evaluation System) methodologies.

ASSET methodology is applied to investigate the safety important events. HPES methodology, which includes several methods (change review, protective barriers review, task review), is used to review the events, connected with human actions.

The criteria for evaluation external events by degree of importance of their analysis and application as well as the procedure for development and implementation of corrective measures are established.

Three categories of external events by degree of their importance for the Armenian NPP are established.

1. **High priority:** Armenian NPP management should immediately get familiar with the information. This category is attributed to the information on the events directly affecting nuclear safety, personnel safety and the NPP reliability.

The category is attributed on the basis of one or several of the following features:

- The event is classified as Level 3 or higher by the INES scale;
- The event reporting is of SOER or SER type;
- The event occurred at the NPP with similar design and there is a possibility of its recurrence at the Armenian NPP, if safety measures are not undertaken;
- The event is important and requires particular attention and respective measures to be undertaken from the point of view of ANRA.

2. **Average priority:** the category is attributed if information meets the following criteria:

- The event is classified as Level 1 or 2 by the INES scale;
- Information is of EAR or ENR reporting type.

3. **For the information:** information does not have high or average priority but it meets application criteria and is distributed among the divisions to get familiarized with. Following the assessment of event importance to the Armenian NPP the information is received by respective subdivisions to review and develop proposals on corrective measures. The review is performed based on "How can this event occur at our NPP?" principle. The event review is performed with application of the following approach:

- How could the plant become vulnerable in regard to the event under consideration (why could such an event occur)?
- Are there any barriers designed to prevent such event at the Armenian NPP and what are the additional barriers required?
- Are reported corrective measures acceptable for the Armenian NPP?
- What are the additional corrective measures to be undertaken?

The information on event and undertaken corrective measures are entered into the Event Database. As a rule the corrective measures are registered in an administrative document and they are not limited by implementation of purely technical measures. The lessons learned from external event analysis are also implemented with the following methods:

- Use of information on external events in personnel training;
- Personnel acknowledgement with information about events by means of booklets.

In the framework of co-operation with WANO event (internal and external) information is exchanged within Information Exchange on Operating Experience program.

The following processes are used as a feedback of important events occurred at other NPPs and implementation of correcting actions:

- Use of information on external events at the Armenian NPP is reported at annual meetings of WANO contact persons;
- Use of event information is also included in the Armenian NPP report presented at annual meetings of WANO-MC Governors' Board (the Armenian NPP is represented by the Armenian NPP General Director);
- Before external reviews are carried out a report on operating experience use (in particular to respond important event reports) and implementation of correcting actions is prepared and submitted to the organization that carries out the review (WANO, IAEA, etc.).

International organizations WANO and IAEA regularly organize workshops/meetings on operating experience issues presenting important industry events. It is used at these meetings to present lessons learned by Armenian NPP from the occurred important events.

Application of industrial operating experience (except for events) by Armenian NPP operating organization is regulated by the guideline "Use of industry operating experience". A procedure is established for analysis of industry operating experience and its use aimed at Armenian NPP operation safety and reliability upgrading.

The following information sources for industry operating experience are used at Armenian NPP:

- Materials of international workshops, reports of IAEA and WANO missions;
- Information from NPPs and international organizations in the framework of bilateral and international co-operation;
- Information from design organizations and equipment suppliers;
- Materials of meetings (twice per year) of Russia, Armenia and Ukraine NPPs managers;
- Materials of IAEA and WANO workshops.

When considering industry operating experience information the principle of maximum learning is used for the lessons that would allow the plant to avoid problems.

Assessment of information on industry experience includes answers to the following questions:

- What are the lessons that could be learned from information?
- What specific actions shall be undertaken at the Armenian NPP to implement good practice or avoid similar problems?

The analysis results are registered in industry operating experience feedback form including recommendations (lessons learned to implement) to use them at the Armenian NPP.

If a need in additional information arises a corresponding organization is requested.

The plant annually sends hundreds of requests to various organizations (operating organizations, NPPs, design organizations and manufacturers) for information concerning improvement of various activity aspects and experience exchange to solve arising problems.

Good practice of other NPPs is used through acknowledgement with results of past international missions (WANO Peer Reviews and IAEA OSART Missions), and active participation of personnel and management in international meetings and conferences.

Good practice of the plant in various activity areas is learned by international missions invited to the Armenian NPP to carry out Peer Review of activity.

We have close relationships with Russian and Eastern European NPPs which have similar design specifications.

Main experience exchange areas include issues of design safety upgrading and improvement of operational safety. Concerning different implementation stages of their modernization and operational safety programs the experience exchange and learning of lessons is the most effective method to correct programs and implement good practice.

In 2005 the operating organization developed Event Data Base. The existing database was developed in regard to all requirements of IAEA guiding documents in the area of operating experience and best practice of the world's NPPs in that area.

All information on events occurred at the plant is entered into the database.

Each event in the database is specified with a set of more than 40 parameters including equipment safety class, the event impact on the unit operating conditions, event consequences, way of event identification, involved personnel, direct and root causes, correcting actions, INES level, etc.

The event data base was installed in the plant network and allows on-line event reporting by all users, receipt of information about the occurred events, status of investigation, correcting actions, etc.

Use of coding system for event parameters in the database allows performing selection by any event parameters. In addition the database allows receiving more than 85 standard statistic requests, such as:

- Event by failure type;
- Event by direct causes;
- Event by root causes;
- Event by for safety class of the failed equipment;
- By categories of insignificant events;
- By problem of insignificant event.

As of January 1, 2019, the database contains detailed information on more than 20300 plant events, and information on more than 6000 events occurred at other plants worldwide.

The updated version of the event database is ready and is in the process of validation (trial use).

ANRA reviews and approves licensee programmes and procedures of safety related activities and their changes. ANRA provides inputs to IRS and INES, and also studies inputs made to these information systems by other countries. ANRA also uses the information on operational events received from the WWER Regulators Forum. ANRA also requires Armenian NPP to study the corresponding IRS database reports and to develop corrective actions, which should be transferred to the Corrective Action Program and the Safety Operation Program that are submitted by Armenian NPP to ANRA twice a year as stipulated in the operating license terms and conditions.

## 14.8 MANAGEMENT OF SPENT FUEL AND RADIOACTIVE WASTE ON THE SITE

The wet storage in Armenian NPP spent fuel pools, handling and transport of the spent nuclear fuel are performed in line with the established national regulations, the adopted Russian Regulatory document “Rules of safety at storage and transport of nuclear fuel at NPPs ”, IAEA Specific Safety Guide “Storage of Spent Nuclear Fuel” as well as in line with the terms and conditions of the granted licenses. NUHOMS type horizontal dry spent fuel storage facility located at the Armenian NPP site was licensed according to the US NRC requirements, particularly, 10CFR Part 72 “Licensing requirements for the independent storage of spent nuclear fuel, high-level radioactive waste, and reactor-related greater than class C”, “Standard Review Plan for Spent Fuel Dry Storage Facilities” (NUREG-1567), Standard Review Plan for Dry Cask Storage Systems (NUREG-1536).

Spent fuel assemblies are unloaded into spent fuel pools of Unit№2 and Unit№1 for precooling for 5-12 years depending on initial U-235 enrichment and discharge burnup.

After reaching required design acceptance criteria on residual decay heat, neutron and gamma doses, spent fuel assemblies are stored in the dry spent fuel storage facility.

The dry spent fuel storage facility (DSFS) consists of two extensions:

- The first extension consists of 11 HSM operated from the year 2000 - filled completely.
- The first part of the second extension consists of 12 HSM operated since 2008 - filled completely. The second part of the second extension consists of 12 HSM operated from 2016, and only 8 HSM are filled.

The operation of the dry spent fuel storage facility is implemented in accordance with the operational license granted by ANRA in 2000 (for the first module of the DSFS) and 2008 (for the second and third modules of the DSFS) and a number of relevant on-site procedures and programs such as:

- Program on shipment of transport container/dry shield canister to the dry spent fuel storage facility;
- Loading of spent fuel assembly in the transport cask/dry shield canister;
- Procedure on accounting and control of nuclear fuel at Armenian NPP;
- General procedure on loading of spent nuclear fuel into the dry spent fuel storage facility.

In the Republic of Armenia radioactive waste is generated from the operation of Armenian NPP and from certain applications in medicine, industry, research and other practices. The handling of radioactive waste is performed in line with the established national regulations, international requirements and terms and conditions of the granted licenses. The list of existing legal acts related to the safety of radioactive waste management is provided in Annex 2 of the national report.

During the reporting period, the Republic of Armenia has ratified the Comprehensive & Enhanced Partnership Agreement between the European Union & Armenia and the Government of Armenia undertakes measures to harmonize the existing legal framework in line with the requirements of the EU corresponding directives.

The second national report of the Republic of Armenia under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (hereinafter referred to as the Joint Convention) was submitted for the review and discussion to the Contracting Parties pursuant to the Article 30 of the Joint Convention, in May 2018 and contains a more detailed information about the radioactive waste management in Armenia.

The "Strategy on Safe Management of Radioactive Waste and Spent Fuel in RA" has been approved under the RA Government Protocol Decision № 42 as of October 5, 2017. The National Strategy follows the "two level strategy" formulation approach (i.e. national strategy sets key issues in general terms and its detailed implementation is delegated to strategies of spent fuel and radioactive waste managing companies).

The National Strategy covers the period of 2018-2088 and sets provisions for:

- Expanding existing DSFS facility (dry horizontal storage technology);
- Constructing DSFS facility (vertical storage technology use of dual purpose casks);
- Establishing the National Operator, a state entity responsible for radioactive waste long term management;
- Introducing "polluter pays" principle and establishment of special "off budget" account;
- Enhancing measures to control the generation of radioactive waste;
- Implementing activities for disposal of VLLW, LLW and ILW (short-lived waste) in a near surface formations (site selection, design, construction, operation) considering the opportunity of expansion of disposal capacity after the decommissioning of Armenian NPP;
- Implementing R&D on feasibility of radioactive waste disposal in geological formations in RA (the need for international support is highlighted therein);
- Enhancing the radioactive waste processing and storage capabilities;
- Implementing measures for personnel recruitment/training;
- Establishing electronic database for radioactive waste accounting and control;
- Developing and submitting the Action Plan for implementation of strategic goals for the RA Government's approval.

To achieve the strategic goals the RA Government adopted Decree №3-L as of 10 January 2019 on approval of 2019-2026 action plan –schedule on implementation of provisions stipulated in strategy on safe management of radioactive waste and spent nuclear fuel in the Republic of Armenia. It

identifies the responsible authorities/entities, timeframes, funding for activities included therein and as well the supervision of implementation/control mechanisms and, inter alia, incorporates Armenian NPP activities on enhancement of spent fuel and radioactive waste management specified in the corresponding programs. For implementation of the activities stipulated in the Action Plan, a "Working group" is established by the Ministry of Territorial Administration and Infrastructure of RA, which is the state competent authority, empowered with the radioactive waste management related issues.

The Law on Safe Utilization of Atomic Energy for Peaceful Purposes, adopted on March 01, 1999 by the National Assembly (Parliament) of the Republic of Armenia, is the basic legal document for settling relations in the field of the atomic energy utilization. The definition of radioactive waste is provided in the Article 3 of the mentioned Law, which stipulates: "radioactive waste is a radioactive material or a surface contaminated radioactive material for which no further use is foreseen and which is subject to isolation from environment".

The RA Government Decree № 631-N as of 04.06.2009 on approval of procedure on radioactive waste management specifies requirements to the radioactive waste management. The last amendment in the document made by the Government Decree № 1324 N as of January 01, 2016 introduces new requirements for the characterization of radioactive waste, waste form and waste package in compliance with the IAEA Safety Standards. In pursuant to the mentioned document the radioactive waste is characterized according to the exposure properties, physical and chemical properties and the biological properties. The radioactive waste form and waste package the characterization shall be performed according to their radiation properties, physical and chemical properties.

The Radiation Safety Norms specifies also the clearance or conditional clearance levels from regulatory control for moderate and bulk amount of materials.

Management practice of radioactive waste at Armenian NPP site is implemented in compliance with national and international regulations, as well as guides and internal procedures and instructions.

All liquids from Armenian NPP controlled area are collected and evaporated continuously, the result of which is the evaporation concentrate (EC). Due to the continuous evaporation of the accumulated liquids the low level sorbents tanks at the Armenian NPP are empty. The generated EC (intermediate level liquid radioactive waste) further undergoes treatment at the deep evaporation facility (DEF). The produced "salt cake" is packed at the metal containers, solidified there and placed for storage at the temporary storage site dedicated for the DEF containers.

At present, the temporary storage site is full and the intermediate storage facility is used as an interim solution for storing the DEF containers.

Solid radioactive waste generated at Armenian NPP site, before transportation to the appropriate storage facility, undergoes preliminary treatment, which include:

- Collection;
- Classification according to activity;
- Fragmentation (if needed);
- Packaging;
- Placement in interim containers;
- Transportation and placement in corresponding storage facilities.

Currently no treatment or conditioning technologies for solid radioactive wastes processing are implemented at Armenian NPP site.

Due to the continuous purification technology through the special gas purification system there is no gaseous radioactive waste accumulated at Armenian NPP.

The radioactive waste management facilities existing at Armenian NPP site are included in Armenian NPP design and are covered by the license issued by ANRA in 2011 for operation of Armenian NPP

Unit № 2. At the Armenian NPP site there are storage systems for solid low, intermediate and high level wastes, as well as storage systems for liquid radioactive waste.

Information on radioactive waste storage facilities' fullness at the Armenian NPP as of 31.12.2018 is provided in Annex 9 of the national report.

The provisions to control and to minimize the generation of radioactive waste are stipulated in the RA legislation. In particular, the National Strategy stipulates undertaking measures for minimization of the generation of radioactive waste. Similar provision is stipulated in the paragraph 17 of the RA Government Decree № 631-N as of 04.06.2009 on approval of Procedure on Radioactive Waste Management. Minimization of the radioactive waste generation is one provisions included in the terms and conditions of the license granted by the ANRA for operation of the nuclear installation, which is verified during the inspections performed by ANRA.

Furthermore, application of the clearance levels established under the Radiation Safety Norms are also provisions made for radioactive waste minimization.

There are guiding and operational documentation at Armenian NPP that regulates the radioactive waste generation. The mentioned documentation regulates the radioactive waste management sequence and procedure, namely the radioactive waste management procedures, responsible persons, solid radioactive waste transportation paths, radioactive waste accounting and monitoring of storage facilities status.

To keep the amount of waste generated at Armenian NPP to the minimum practicable ANPP performs a number of activities and established several procedures and appropriate documentation, such as:

- Program on minimization of solid radioactive waste ;
- Guidance on minimization of solid radioactive waste at Armenian NPP.

In 2018 ANPP developed, approved and agreed with the ANRA a "Program of Activities for Management of Existing radioactive waste and generating radioactive waste during the extended lifetime of Armenian NPP unit № 2" (hereinafter - program). the mentioned program is aimed at bringing the radioactive waste management system of Armenian NPP into line with the international and national requirements existing in the area of atomic energy use in the RA and requirements of the IAEA safety standards.

The activities on implementation of the Program provisions are planned for 2018-2023. The program consists of four projects:

Project 1. Development and implementation of the radioactive waste accounting and monitoring system.

Project 2. Modernization of the liquid radioactive waste processing system, which includes:

a. Modification of DEF for the liquid radioactive waste treatment;
b. Processing of crystal sediments in the evaporator residue tanks.

Project 3. Modernization of the solid radioactive waste processing system, for which the following actions are planned:

a. Commissioning of the facility for processing of the solid radioactive waste;
b. Purchasing and commissioning of equipment for characterization and certification of radioactive waste;
c. Processing of "salt cake" from the DEF of the liquid radioactive waste and spent ion exchanging resins from high level sorbent tanks.

Project 4. Establishment of capacities for storage of the conditioned radioactive waste, which includes:

a. Modification of the solid low level radioactive waste storage facility;

b. Construction of a new storage facility for storage of the conditioned waste.

Implementation of the Program activities will lead to the safe management of existing and correspondingly for radioactive waste to be generated during lifetime extension of Unit 2. It will provide also capabilities for the management of radioactive waste generated from the Armenian NPP decommissioning.

The clearance levels are established in the Radiation Safety Norms approved under the RA Government Decree № 1219 as of August 18, 2006 and amended in 2014 aimed to bring them in compliance with the IAEA GSR Part 3.

No radioactive waste clearance is implemented at Armenian NPP.

ANRA performs the regulatory control over the radioactive waste management at Armenian NPP through review of reports (quarterly and annual) on radioactive waste, information on fulfillment of NPP operational license terms and conditions, information on upgrade/modernization of radioactive waste management system, and other documents. Besides, the ANRA performs inspections, usually 2-3 planned inspections per year to verify the compliance of radioactive waste management practices at the Armenian NPP with the safety requirements, the current state of activities specified in the submittals and the accuracy of information contained therein, the information on implementation of enforcement actions imposed earlier, etc.

## ANNEX 1. THE INTERNATIONAL TREATIES RATIFIED BY THE REPUBLIC OF ARMENIA

Convention on Early Notification about Nuclear Accident ratified on 22.06.1993

Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency ratified on 22.06.1993

Vienna Convention on Civil Liability for Nuclear Damage ratified on 22.06.1993

Convention on Physical Protection of a Nuclear Material ratified on 22.06.1993

CTBT Comprehensive Nuclear-Test-Ban Treaty ratified on 21.12.1993

Convention on Nuclear Safety ratified on 24.09.1997

Treaty on the Non-Proliferation of Nuclear Weapons ratified on 24.09.1991

Agreement between the Republic Armenia and the International Atomic Energy Agency for the Application of Safeguards in connection with Treaty on the Non-Proliferation of Nuclear Weapon signed on 23.09.1993

Protocol Additional to the Agreement between the Republic Armenia and the International Atomic Energy Agency for "The Application of Safeguards in connection with Treaty on the Non-Proliferation of Nuclear Weapon ratified on 28.06 2004

Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the International Atomic Energy Agency to the Government of the Republic of Armenia ratified on 04.06 2003

Amendment to the Convention on Physical Protection of Nuclear Material ratified on 18.03.2013

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management ratified on 21.03.2013

## ANNEX 2. GOVERNMENT DECREES ADOPTED IN ATOMIC ENERGY UTILIZATION FIELD

### Laws in Atomic Energy Utilization Field

Law on Safe Utilization of Atomic Energy for Peaceful Purposes (01.02.1999 HO-285)

Law of the RA on Licensing (30.05.2001 NO-193 with supplements as of 16.03.2004 HO-52N)

Code of the RA on Administrative Offences

Law of the RA on Normative Legal Acts (21.03.2018 HO-180N)

Law of the RA on Civil Service (03.2018 HO 205 N)

Law of the RA on Population Protection in case of Emergencies (02.12.1998 HO-265)

Law of the RA on Organization and Conduct of Inspections (17.05.2000 HO-172)

Criminal Code of the RA (18.04.2003)

Law of the RA on Administration Bases and Administrative Procedure (18.02.2004 HO-41N)

Law of the RA on Taxes (10.02.1998 HO-12)

Law of the RA on Environmental Impact Expertise (12.10.1995 HO-21)

Law of the RA on state authorities (3003.018 HO-260-Ն)

### Legal Acts in Atomic Energy Utilization Field

Government Decree № 573 as of 16.11.1993 on establishment of the state authority under the government of the RA on regulation of nuclear and radiation safety for atomic energy utilization(Armenian Nuclear Regulatory Authority)

Government Decree № 768 as of 22.12.1999 on approval of the list of activities and positions of authority important for safety in atomic energy utilization

Government Decree № 342 as of 25.04.2001 on establishment of the scientific and technical center on Nuclear and Radiation Safety, CJS

Government Decree № 452 as of 24.05.2001 on transfer of responsibilities for regulation of safety of ionizing radiation sources and protection against ionizing radiation in the Republic of Armenia to ANRA

Government Decree № 640 as of 12.07.2001 on approval of the procedure for organization and conduct of safety expertise in the atomic energy utilization field

Government Decree № 765 as of 16.08.2001 on approval of the procedure for registration of ionizing radiation sources

Government Decree № 1263 as of 24.12.2001 on approval of the special rules on transport of nuclear and radioactive materials

Government Decree № 931-N as of 27.06.2002 on approval of the procedure for safe transport of nuclear and radioactive materials

Government decree № 1231-N as of 11.09.2003 on approval of the concept of physical protection and security of Armenian NPP and nuclear materials and rules on physical protection of nuclear installations and nuclear materials

Government Decree № 2013-N as of 21.11.2002 on approval of the requirements to form and contents of the Safety Analysis Report of the Armenian NPP Unit 2

Government Decree № 1597-N as of 26.10.2004 on fulfillment of obligations undertaken under the Protocol Additional to the Agreement between the Republic of Armenia and the International Atomic

Energy Agency for "The Application of Safeguards in Connection with Treaty on the Non-Proliferation of Nuclear Weapons"

Government Decree № 1751-N as of 09.12. 2004 on approval of the licensing procedure and license form for use of radioactive materials, devices containing radioactive materials, or radiation generators

Government Decree № 1790-N as of 09.12. 2004 on approval of the licensing procedure, license and application form for import and export of radioactive materials, devices containing radioactive materials, or radiation generators

Government Decree № 1791-N as of 09.02. 2005 on approval of the licensing procedure and license form for storage of radioactive materials, devices containing radioactive materials, or radiation generators

Government Decree № 1792-N as of 09.02. 2005 on approval of the licensing procedure for transport of radioactive materials, devices containing radioactive materials, or radiation generators

Government Decree № 257-N as of 10.02. 2005 on approval of the licensing procedure and license form for designing of systems, structures and components important to safety of atomic energy utilization installation

Government Decree № 258-N as of 10.02. 2005 on approval of the licensing procedure and license form for manufacture of systems, structures and components important to safety of atomic energy utilization installation

Government Decree № 259-N as of 10.02. 2005 on approval of the licensing procedure and license form for repair of radioactive materials, devices containing radioactive materials, or radiation generators

Government Decree № 260-N as of 10.02. 2005 on approval of the licensing procedure and license form for installation and calibration of radioactive materials, devices containing radioactive materials, or radiation generators

Government Decree № 345-N as of 24.03.2005 on approval of the licensing procedure and license form for expertise of atomic energy utilization installations, their designs and other documents

Government Decree № 375-N as of 24.03.2005 on approval of the licensing procedure and license form for import and export of radioactive wastes

Government Decree № 400-N as of 24.03. 2005 on approval of the licensing procedure and license form for operation of nuclear installations

Government Decree № 401-N as of 31.03. 2005 on approval of the licensing procedure and license form for implementation of physical protection of nuclear installations and nuclear materials

Government Decree № 416-N as of 31.03. 2005 on approval of the licensing procedure and license form for construction of radioactive waste storage facility

Government Decree № 417-N as of 31.03. 2005 on approval of the licensing procedure and license form for construction of radioactive waste disposal facility

Government Decree № 608-N as of 12.05. 2005 on approval of the licensing procedure and license form for designing of nuclear installations

Government Decree № 609-N as of 12.05. 2005 on approval of the licensing procedure and license form for site selection of nuclear installations

Government Decree № 647-N as of 05.05.2005 on approval of the licensing procedure and license form for storage of radioactive wastes

Government Decree № 649-N as of 12.05. 2005 on approval of the licensing procedure and license form for construction of nuclear installations

Government Decree № 652-N as of 19.05. 2005 on approval of the licensing procedure and license form for operation of radioactive waste disposal facility

Government Decree № 702-N as of 19.05. 2005 on approval of the licensing procedure and license form for operation of radioactive waste storage facility

Government Decree № 703-N as of 19.05. 2005 on approval of the licensing procedure and license form for reprocessing of radioactive wastes

Government Decree № 707-N as of 01.06. 2005 on approval of the licensing procedure and license form for decommissioning of nuclear installations

Government Decree № 745-N as of 09.06.2005 on approval of the licensing procedure and license form for storage of nuclear materials

Government Decree № 746-N as of 09.06.2005 on approval of the licensing procedure and license form for transport of nuclear materials

Government Decree № 762-N as of 09.06. 2005 on approval of the licensing procedure and license form for use of nuclear materials

Government Decree № 985-N as of 07.07. 2005 on approval of the licensing procedure and license form for designing of radioactive waste storage facility

Government Decree № 986-N as of 07.07. 2005 on approval of the licensing procedure and license form for designing of radioactive waste disposal facility

Government Decree № 1204-N as of 11.08. 2005 on approval of the licensing procedure and license form for site selection of radioactive waste disposal facility

Government Decree № 2129-N as of 01.12. 2005 on approval of the licensing procedure and license form for decommissioning of radioactive waste disposal facility

Government Decree № 2140-N as of 01.12. 2005 on approval of the licensing procedure and license form for manufacture of radioactive materials, equipment containing radioactive materials, or radiation generators

Government Decree № 2141-N as of 01.12. 2005 on approval of the licensing procedure and license form for decommissioning of radioactive waste storage facility

Government Decree № 1219-N as of 18.08.2006 on approval of radiation safety norms

Government Decree № 1489-N as of 18.08.2006 on approval of radiation safety rules

Government Decree № 1858-N as of 14.12.2006 on approval of the licensing procedure, license and application forms and qualification check of individuals implementing practices and holding positions important for safety of atomic energy utilization field

Government Decree № 1859-N as of 14.12.2006 on approval of amendments to RA Government Decree № 768 as of 22.12.1999

Government Decree № 553-N as of 03.05.2007 on approval of procedure on detection and isolation of radioactive materials

Ordinance of RA President № 121-N as of 20.02.2008 of reorganization of Armenian Nuclear Regulatory Authority (ANRA) under Ministry for Nature Protection of RA into State Committee under Government of RA on nuclear safety regulation and amendment of RA President Ordinance № NH-1063 adopted on 16 March 2002

Government Decree № 587-A as of 29 May 2009 on recognition of the Regulatory Authority

Government Decree № 631-N as of 04.06.2009 on approval of the procedure on radioactive waste management

Government Decree № 418-N as of 05.04.2012 on approval of procedure on investigation of NPP operational events

Government Decree № 461-N as of 19.04.2012 on approval of extension of design lifetime of Armenian NPP Unit No2

Government Decree № 1085-N as of 23.08.2012 on approval of the requirements to extension of design lifetime for Armenian NPP Unit No2 operation

Government Decree № 1411-N as of 08.11.2012 on approval of Design Safety Requirements to New NPP Unit(s).

Government Decree № 1546-N as of 13.12.2012 on approval of Method on Seismic Hazard Assessment for New Nuclear Unit Site.

Government Decree № 708-N as of 04.07.2013 on approval of site safety requirements to new NPP Unit(s);

Government Decree № 709-N as of 04.07.2013 on approval of list of internal legal acts applied in atomic energy utilization field in Russian and in English.

Government Decree №985-A as of 13.09.2013 on appointment of competent authorities for implementation of obligations established in the Amendment to the Convention on the Physical Protection of Nuclear Material. In accordance with the Decree the ANRA and the National Security Service of the RA are recognized as the competent authorities within their respective jurisdictions.

RA Government Decree №14-N adopted on 14.01.2016 on approval of rules on physical protection of radioactive materials and devices containing radioactive materials

RA Government Decree №475-N as of 11.06.2017 on approval of rules on physical protection of nuclear materials and nuclear installations

RA Prime Minister decree №747-L as of 11.06.2018 on approval of ANRA statute

**Subordinate Legal Acts in Atomic Energy Utilization Field**

Requirements to format and content of conclusion on safety expertise in atomic energy utilization field (Registered by the Ministry of Justice of RA. Registration № 10503349 as of 12.11.2003).

Establishment of Armenian NPP emergency planning zones (Registered by the Ministry of Justice of RA. Registration № 12506129 as of 04.05.2006).

Statute and procedure on formation of commission on qualification check of physical persons holding positions and implementing practices important to safety in atomic energy utilization field (Registered by the Ministry of Justice of RA. Registration № 12507398 as of 21.11.2007).

Requirements to content and form of program on decommissioning of nuclear installations (Registered by the Ministry of Justice of RA. Registration № 12511432 as of 27.09.2011).

Requirements on accounting of radioisotopic and ionizing radiation sources at atomic energy utilization installations (Registered by the Ministry of Justice of RA. Registration № 12512188 as of 11.04.2012).

Joint order of ANRA Chairman, RA Minister of Agriculture and RA Minister of Healthcare on approval of Educational Program On Preparedness To Withstand Infectious Diseases, Chemical And Radiation Hazards And The Time Schedule Included in the Program (registered by the Ministry of Justice under the Registration № 1001201 on 18.01.2012)

Requirements to format and content of radiation monitoring system of the nuclear installations (registered by the Ministry of Justice under the Registration № 12512230 on 31.05.2012)

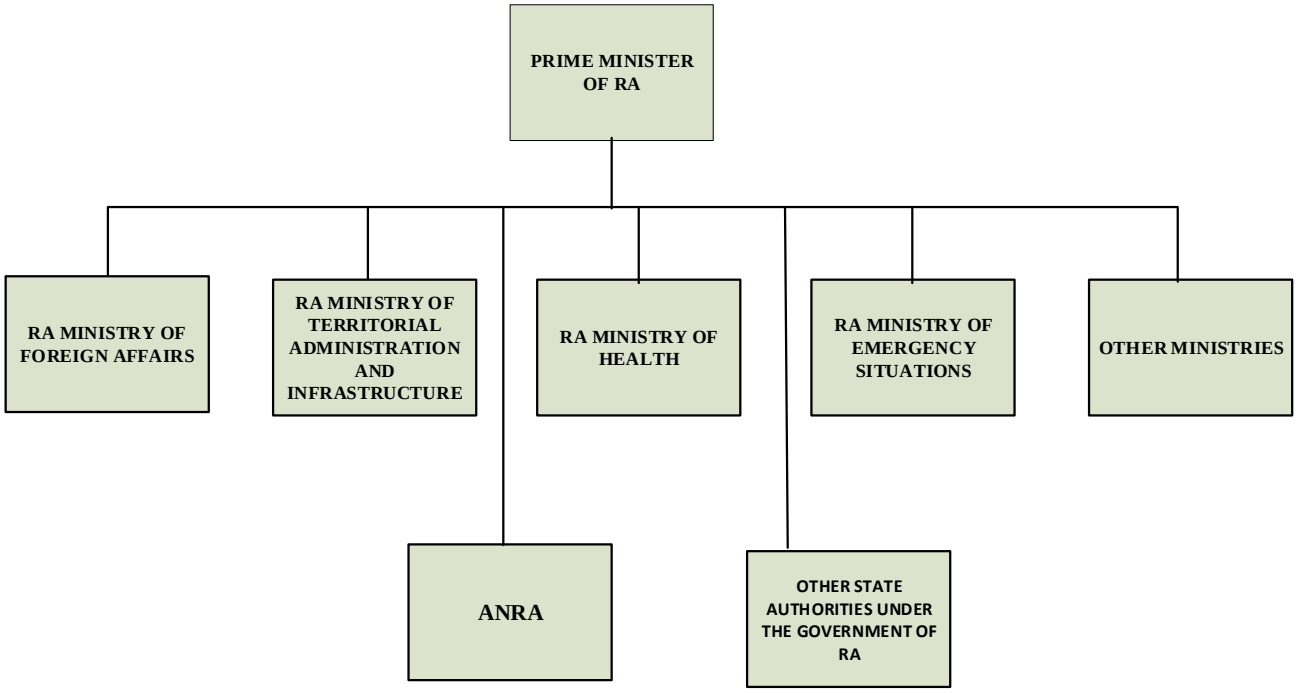
Requirements to form and maintaining the individual occupational radiation cards (registered by the Ministry of Justice under the Registration № 12513109 on 25.03.2013)

Requirements to format and content of comprehensive survey report (registered by the Ministry of Justice under the Registration №12516039 on 04.02.2016)

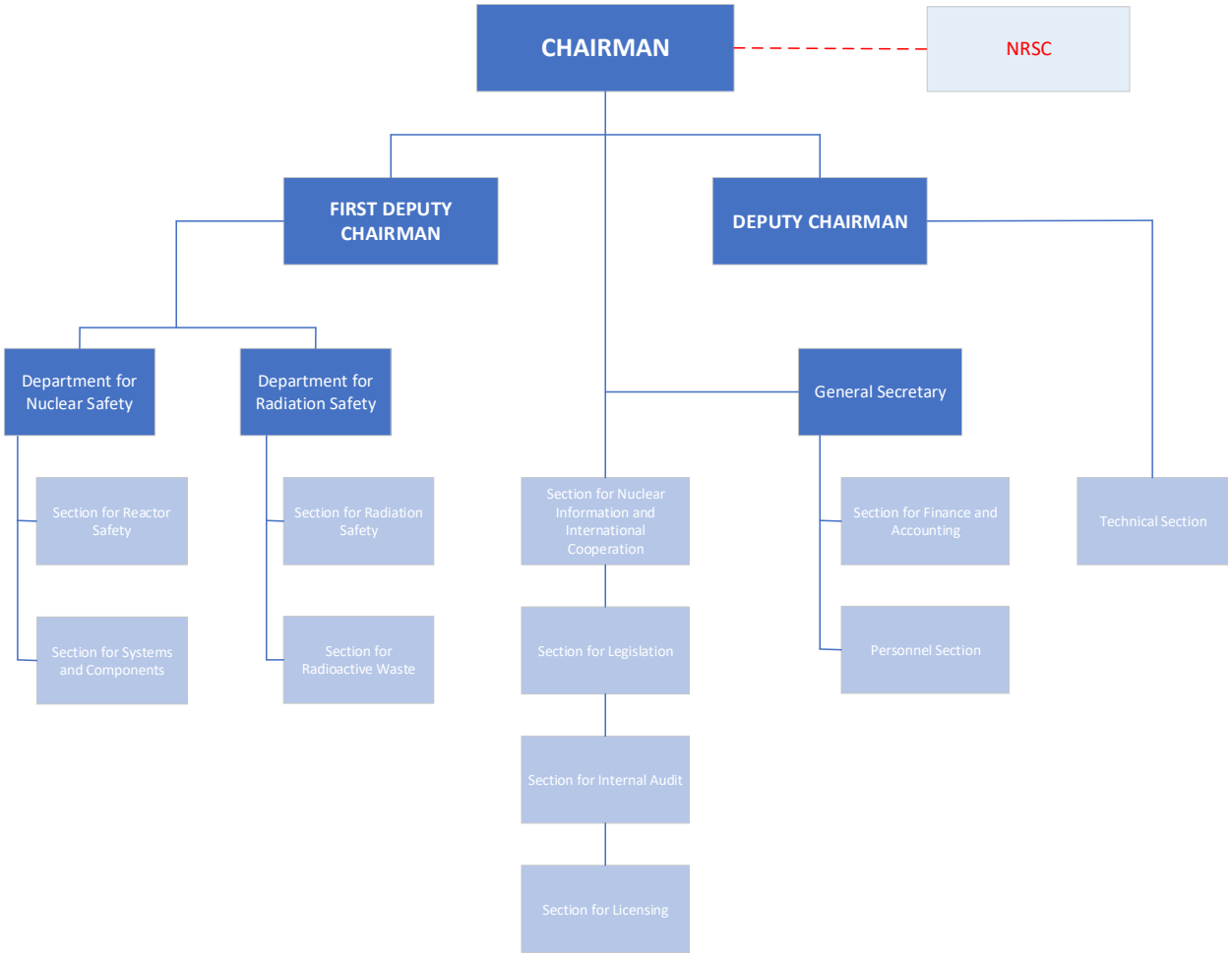
**ANNEX 3. ROAD MAP**

| Timing | Measure | Possible EU assistance |
|---|---|---|
| | **The new law of the Republic of Armenia on safe utilization of atomic energy for peaceful purposes** | |
| End of 2018 | Development – "0" draft | |
| 1st half of 2019 | Expertize (IAEA, EU) | |
| 2nd half of 2019 | Revision of the draft taking into account the results of the expertize and Submission to the Government | Expertize |
| 1st half of 2020 | Submission of the revised draft to the National Assembly of the RA | |
| | **Ascertain compliance with the requirements of the European Union Safety Directives** | |
| 5 years after the entry into force CEPA | COUNCIL DIRECTIVE 2006/117/EURATOM of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel | Expertize |
| 4 years after the entry into force CEPA | COUNCIL DIRECTIVE 2009/71/EURATOM of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations | Expertize |
| 4 years after the entry into force CEPA | COUNCIL DIRECTIVE 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste | Expertize |
| 5 years after the entry into force CEPA | COUNCIL DIRECTIVE 2013/51/EURATOM of 22 October 2013 laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption | Expertize |
| 5 years after the entry into force CEPA | COUNCIL DIRECTIVE 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom | Expertize |

## ANNEX 4. POSITION OF ANRA IN THE RA GOVERNMENT STRUCTURE



## ANNEX 5. ORGANIZATIONAL STRUCTURE OF ANRA



## ANNEX 6. RADIATION PROTECTION

Table 1. Annual Allowable Release of Radioactive Gases and Airborne into the Atmosphere

| Radionuclide | WWER NPP |
|---|---|
| Noble gases [TBq] | 690 |
| $^{131}$I [GBq] (gas and airborne) | 18 |
| $^{60}$Co [GBq] | 7.4 |
| $^{134}$Cs [GBq] | 0.9 |
| $^{137}$Cs [GBq] | 2.0 |

Table 2. Control Levels for Release of Radioactive Gases and Airborne into the Atmosphere per Month

| Radionuclides | WWER NPP |
|---|---|
| Nobel gases [TBq] | 57 |
| $^{131}$I [GBq] (gas and aerosols) | 1.5 |
| $^{60}$Co [MBq] | 620 |
| $^{134}$Cs [MBq] | 75 |
| $^{137}$Cs [MBq] | 170 |

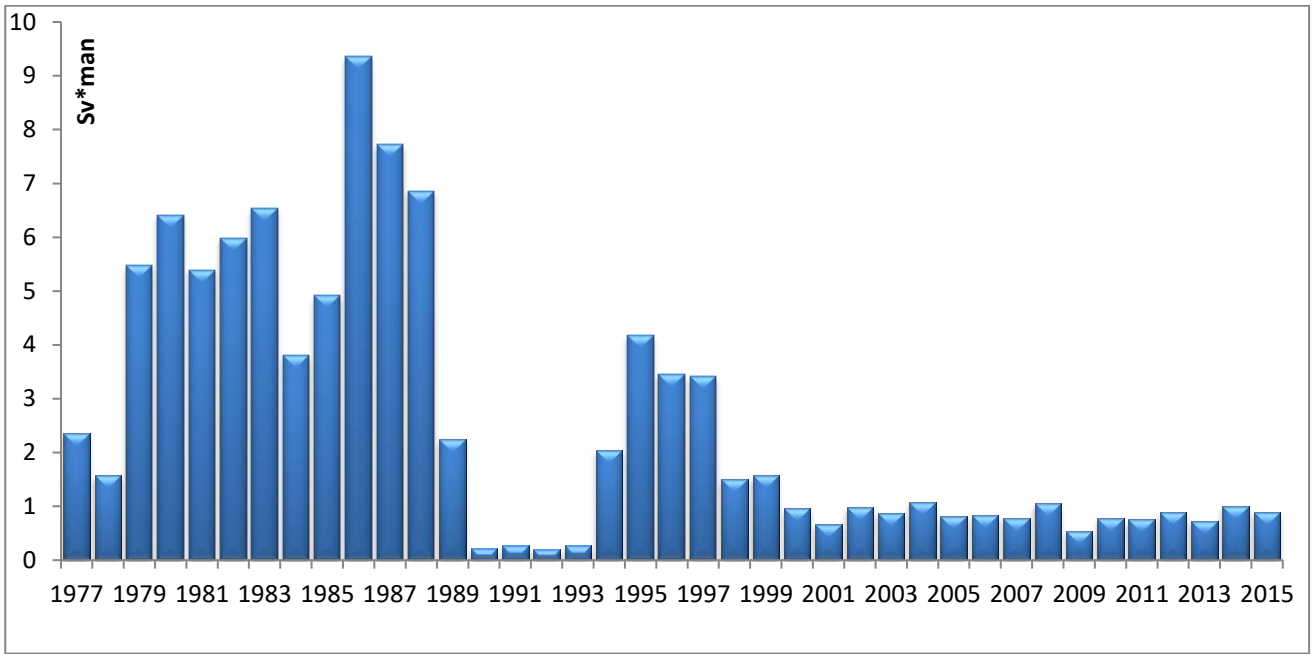



Figure 1. Annual Collective Equivalent Exposure Dose of Armenian NPP Personnel

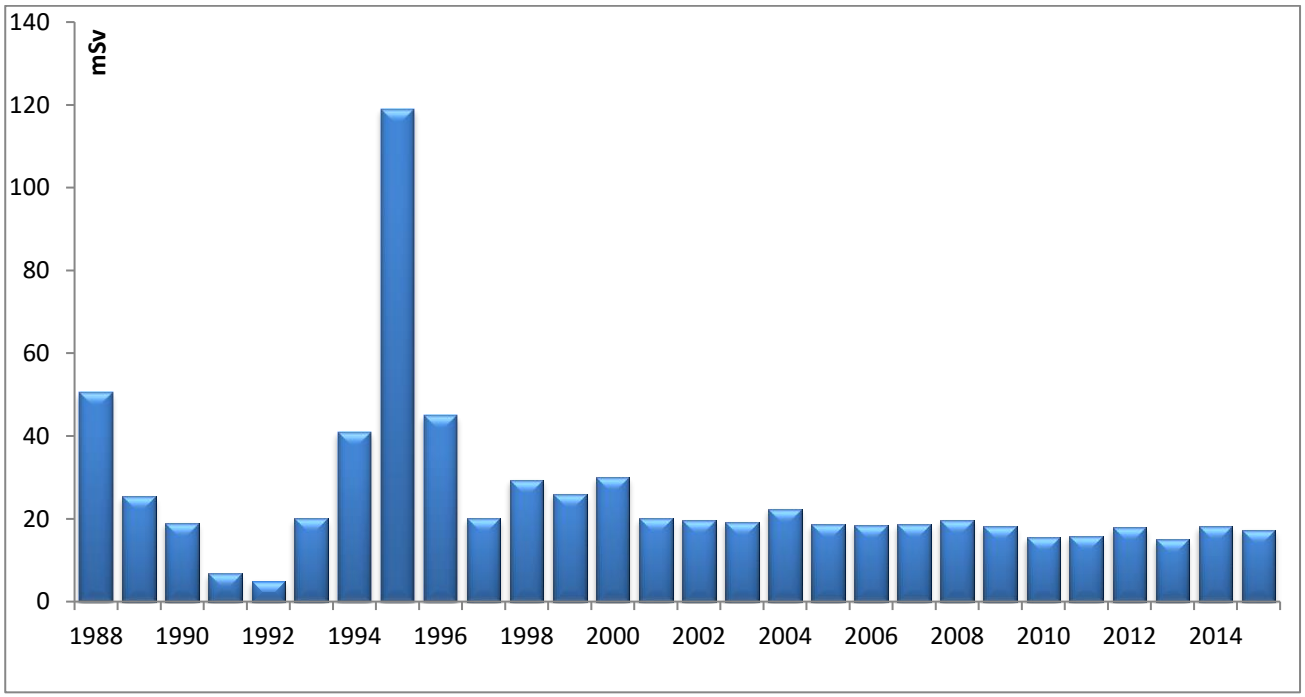



Figure 2. Individual Equivalent Annual Maximum Exposure Dose of Armenian NPP Personnel for the period 1988-2015

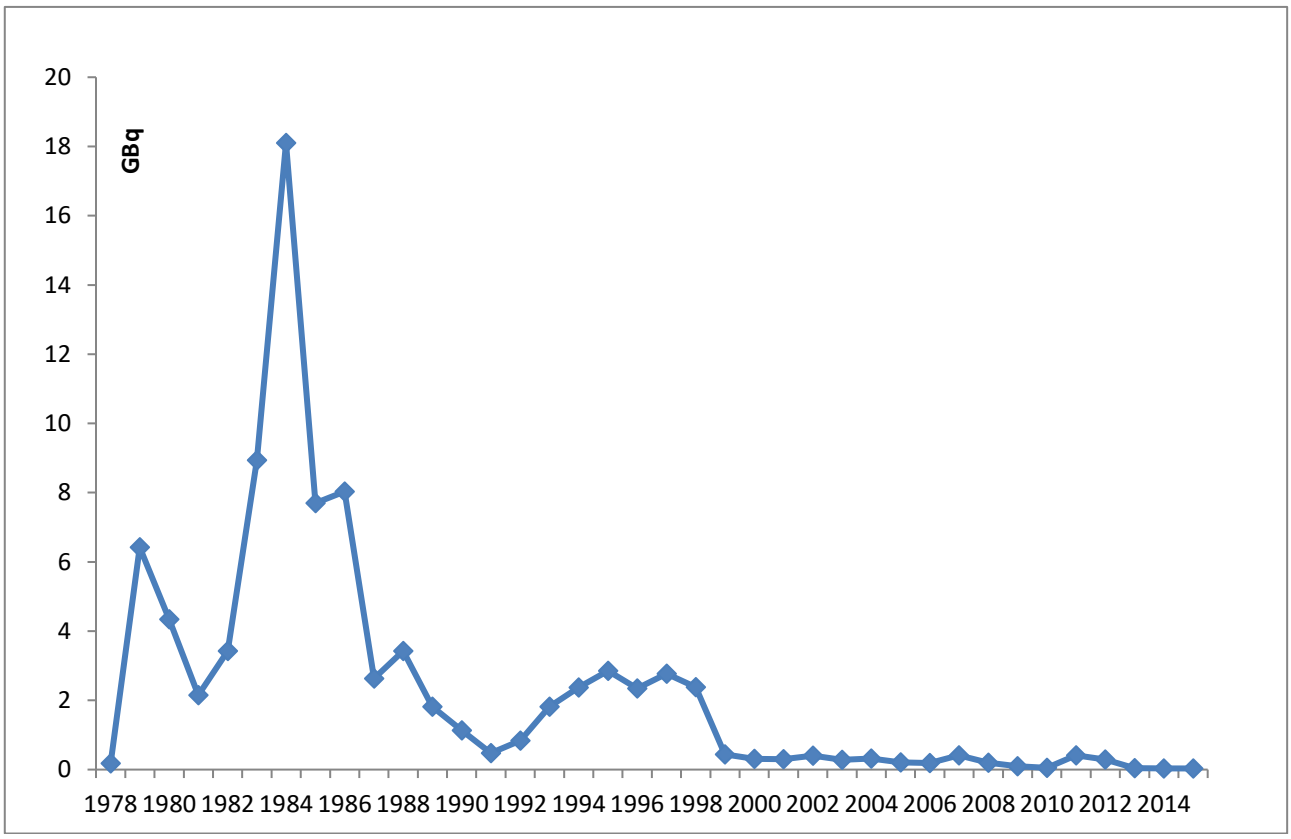



Figure 3. Annual Releases of Long-Lived Radionuclides (T1/2 more 24 hours) for the period of the Armenian NPP operation

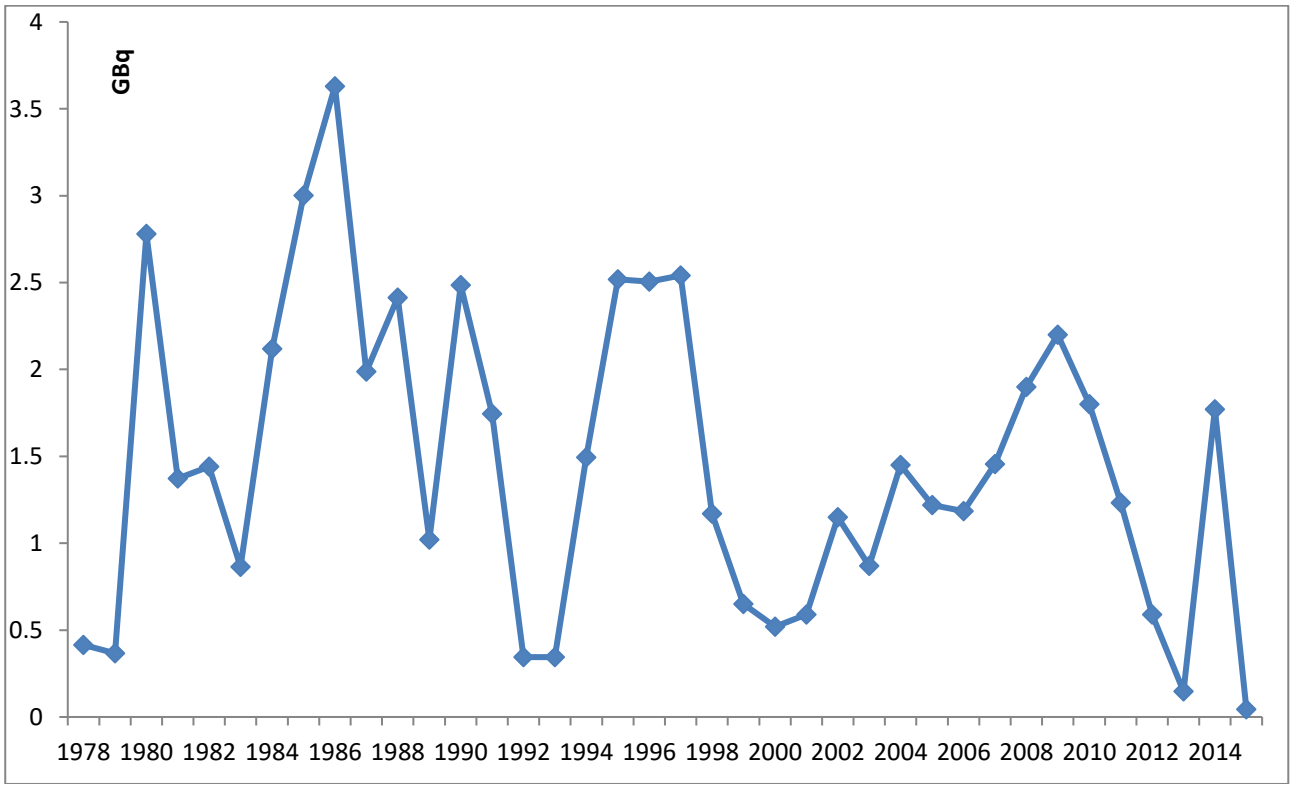



Figure 4. Annual Discharges of Long-Lived Radionuclides (Sr+Cs) from Armenian NPP in the period of operation

**Environmental Radiation Monitoring Results for 2015**

Table 1. The contamination of atmosphere* in the Armenian NPP supervised area in 2015 [$10^{-4}$ Bq/$m^3$]

| Name of location | Summary beta activity | $^{137}Cs$ | $^{90}Sr$ | $^{7}Be$** |
|---|---|---|---|---|
| Armenian NPP - 1 km | 0.63 | 0.022 | 0.005 | 5.6 |
| Metsamor town - 5 km | 1.06 | 0.032 | 0.004 | 5.70 |
| Water purification system of Armenian NPP - 6-7km | 1.16 | 0.05 | 0.005 | 8.10 |
| Yerevan city – 30 km (clean area for comparison of data) | 1.22 | 0.05 | 0.004 | 8.7 |

*) Boundary limit values of $^{137}Cs$ in atmosphere equals 27 Bq/$m^3$, $^{90}Sr$ - 2.7 Bq/$m^3$ , $^{7}Be$ - 1,900 kBq/$m^3$
(Radiation safety norms, table 3)

**) $^{7}Be$ is a radioactive isotope of cosmic origin.

Table 2. Contamination of soil in the Armenian NPP supervised are in 2015 [Bq/kg]

| Name of location | Cs-134 | Co-60 | Ag-110m | Cs-137 | Sr- 90 |
|---|---|---|---|---|---|
| Armenian NPP | - | - | - | 19.2 | 1.70 |
| Territory with 3-6 km radius | - | - | - | 8.5 | 1.20 |
| Territory with 8-12 km radius | - | - | - | 6.80 | 1.40 |
| Territory with 14-18 km radius | - | - | - | 11.80 | 1.10 |
| Yerevan city – 30 km (clean area for comparison of data) | - | - | - | 14.7 | 1.0 |

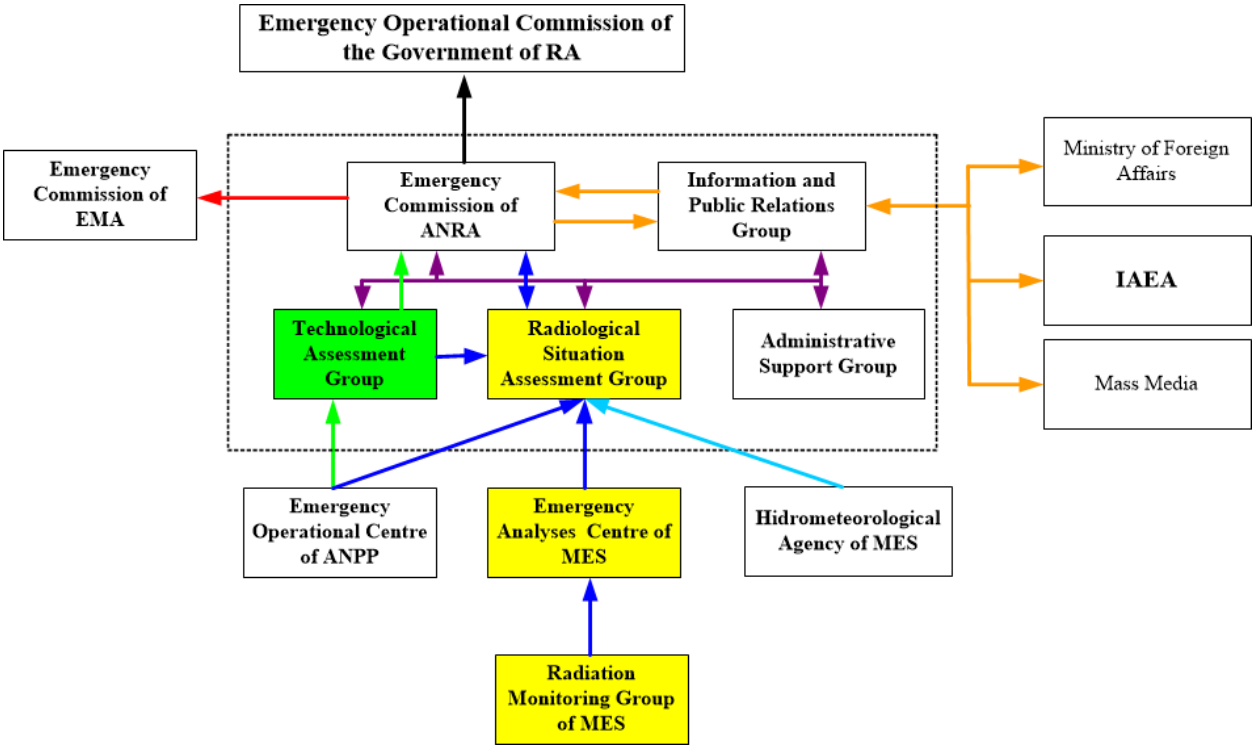
**No radioactive isotopes generated due to operation of the Armenian NPP are available in the soil and vegetation of the Armenian NPP supervised area.**

Table 3. Quantity of $^{137}Cs$ and $^{90}Sr$ radioisotopes in open reservoir of the Armenian NPP supervised area in 2015 [Bq/$m^3$ ]

| Name of open reservoir | Radioactive isotopes | |
|---|---|---|
| | $^{137}Cs$ | $^{90}Sr$ |
| Lake Aknalich | 10..0 | 3.50 |
| Fishery Facility | 13.50 | 25.0 |
| Service Water Supply Pump Facility | 17.0 | 1.95 |
| Drinking Water Sampling for Metsamor | 20.5 | 2.50 |
| Drinking Water Sampling for Armavir | 13.5 | 3.5 |
| Sanitary Sewage Discharge Point | 12.5 | 3.5 |
| Site Rainwater Sewage Discharge Point | 13.5 | 1.5 |
| Big reservoir of Armavir | Dry water | Dry water |

The limiting value of $^{137}Cs$ in open reservoirs is 11* $10^3$ Bq/$m^3$, and the limiting value of $^{90}Sr$ is 5* $10^3$ Bq/$m^3$, (Radiation safety norms, table 3)

## ANNEX 7. SCHEME OF ANRA EMERGENCY RESPONSE AND INTERACTION WITH EXTERNAL ORGANIZATIONS



## ANNEX 8. ARMENIAN NPP NOTIFICATION SCHEME

NPP SS

| № | Position |
|---|---|
| 1. | Armenian NPP General Director |
| 2. | Armenian NPP Chief Engineer |
| 3. | Co-coordinator of the ANRA Emergency Response Center |
| 4. | Chairman of the ANRA |
| 5. | Duty operator of the RA MES Rescue Team |
| 6. | Duty operator of Armavir Marz Rescue Administration |
| 7. | Head of Nuclear Energy Administration of the Ministry of Energy and Natural Resources |

The functions of Leading Engineer of Electrical Control Board/Duty Electrician

**When "Preparedness" is declared:**

1. Notification of ANPP key positions

**When "Local accident" is declared:**

1. Connection of acoustic alarm at Armenian NPP site
2. Notification of call personnel according to the list
3. Notification of Armenian NPP key positions

**When "General Accident" is declared:**

1. Connection of acoustic alarm at Armenian NPP site
2. Notification of populated areas of Preventive and Protective Measures Zone (Aknalich, Arshaluys, Mayisyan, Metsamor, Ferik, Yedesia)
3. Notification of call personnel according to the list

## ANNEX 9. RADIOACTIVE WASTE MANAGEMENT

Fullness of radioactive waste storage facilities at the Armenian NPP as of 31.12.2018

| № | Storage facility | Storage capacity $m^3$ | Accumulated RW | | Notes |
|---|---|---|---|---|---|
| | | | $m^3$ | % (fullness) | |
| 1. | Solid LLW storage facility | 17051 | 6625.72 | 39 | |
| 2. | Solid ILW storage facility | 1001 | 473.568 | 47 | Incl. 367.06 $m^3$ "salt cake" (1691 DEF cont.) |
| 3. | Solid HLW storage facility | 78.34 | 35.394 | 45 | |
| 4. | DEF containers temporary storage site | Max. 3000 containers | 435.16 (1978 DEF containers) | 100 | |
| 5. | Liquid RW storage facility | 510 | --- | --- | Due to the continuous evaporation there are no accumulated liquids. |
| 6. | Liquid ILW storage facility (6 ECT, HLST-1) | 3170 | 2340,7 | 74 | |
| 7. | Liquid HLW storage facility (HLST-2) | 350 | 163 | 47 | |

## LIST OF ABBREVIATIONS

| | |
|---|---|
| ALARA | As Low as Reasonably Achievable |
| ANL | Argon National Laboratory |
| ANRA | Armenian Nuclear Regulatory Authority |
| Armenian NPP | Armenian Nuclear Power Plant |
| ARS | Armenian Rescue Service |
| ASSET | Assessment of Safety Significant Events |
| BDBA | Beyond Design Basis Accident |
| BDBE | Beyond Design Basis Earthquake |
| BNL | Brookhaven National Laboratory |
| CES | Commission on Emergency Situations |
| CDF | Core Damage Frequency |
| CMC | Crisis Management Centre |
| CPR | Corporate Peer Review |
| CSF | Critical Safety Functions |
| DAR DG | System of Additional Emergency Cooling by Diesel Generator |
| DBA | Design Basis Accident |
| DEF | Deep Evaporation Facility |
| DG | Diesel Generator |
| DGS | Diesel Generator Station |
| DSC | Dry Shielding Container |
| DSFS | Dry Spent Fuel Storage Facility |
| EAR | Event Analysis Report |
| EC | European Commission |
| ECCS | Emergency Core Cooling System |
| EDG | Emergency Diesel Generator |
| ENR | Event Notification Report |
| ENSREG | European Nuclear Safety Regulators Group |
| EOP | Emergency Operating Procedure |
| ESP | Emergency Shutdown Panel |
| ERC | Emergency Response Center |
| EU | European Union |
| FSA | Fault Sequence Analysis |
| FAST-EE | Fault Sequence Tool for Extreme Events |
| HPES | Human Performance Evaluation System |
| INES | International Nuclear Event Scale Information Service |
| IAEA | International Atomic Energy Agency |
| INSC | Instrument for Nuclear Safety Cooperation |
| IPPAS | International Physical Protection Advisory Service |
| IPSART | International Probabilistic Safety Analysis Review Team |
| IRRS | Integrated Regulatory Review Services |
| IRS | Incident Reporting System |
| I&C | Instrumentation and Control |
| LOCA | Loss of Coolant Accident |
| LTE | Lifetime Extension |
| LTO | Long Term Operation |
| MCR | Main Control Room |
| MCP | Mail Circulation Pipe |
| MDE | Maximum Design Earthquake |
| MELCOR | Severe Accident Analysis Codes |
| MES | Ministry of Emergency Situations |

| | |
|---|---|
| MFS | Multi-functional Simulator |
| ND | Nominal Diameter |
| NPP | Nuclear Power Plant |
| NRSC | Nuclear and Radiation Safety Center |
| OE | Operational Experience |
| OSART | Operational Safety Review Team |
| OED | Operational Experience Department |
| PAMS | Post-Accident Monitoring System |
| PAZ | Preventive Actions Zone |
| PGA | Peak Ground Acceleration |
| PR | Peer Review |
| PRT | Peer Review Team |
| PSA | Probabilistic Safety Assessment |
| PSHA | Probabilistic Seismic Hazard Assessment |
| PROSPER | Peer review of the Effectiveness of the Operational Safety Performance Experience Review |
| PRZ | Pressurizer |
| PTS | Pressurized Thermal Shock |
| SOEOP | Symptom-oriented Emergency Operating Procedures |
| QMS | Quality Management System |
| RA | Republic of Armenia |
| RF | Russian Federation |
| RLE | Reviewed Level Earthquake |
| SSC | Systems, Structures and Components |
| QA | Quality Assurance |
| RDGS | Redundant Diesel Generator Station |
| SALTO | Peer Review Service on Safe Long-Term Operation |
| SAMG | Severe Accident Management Guidelines |
| SAR | Safety Analysis Report |
| SAT | Systematic Approach to Training |
| SER | Significant Event Report |
| SG | Steam Generator |
| SOER | Significant Operating Experience Report |
| SRW | Solid Radioactive Waste |
| SSEL | Safe Shutdown Equipment List |
| TG | Turbine Generator |
| TLD | Thermo-luminescence Dosimeter |
| US NRC | United States Nuclear Regulatory Commission |
| US DOE | United States Department of Energy |
| UPZ | Urgent Protective Actions Zone |
| WANO | World Association of Nuclear Operators |
| WENRA | Western European Nuclear Regulators Association |
| WWER | Water-cooled Water-moderated Energetic Reactor |